Transportation of Juvenile Salmonids on the Snake River, 2006: Final Report for the 2001 and 2002 Fall Chinook Salmon Juvenile Migrations

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EXECUTIVE SUMMARY

The National Marine Fisheries Service began annual studies in 2001 to evaluate the efficacy of transporting Snake River fall Chinook salmon smolts from Lower Snake River hydropower projects. In 2001 and 2002, we tagged hatchery subyearling fall Chinook salmon at Lyons Ferry Hatchery and released them in the Snake River at river kilometer 254, 81 kilometers above Lower Granite Dam. Here we report adult returns from fish recovered during late summer and fall 2006.

Our original study was designed to compare the smolt-to-adult return rate (SAR) of fish transported from Lower Granite Dam with that of fish not detected at any collector dam. However, recent data has shown the model for estimating numbers of non-detected fish, which is used for spring Chinook migrants, cannot be used for Snake River fall Chinook salmon. This model relys on the assumption of equal probabilities of detection for fish from each cohort. However we now know that fall Chinook may delay its downstream migration for several months. Thus, since there is no way to reliably estimate the numbers of non-detected fish that survived to Lower Granite Dam, we report only the SARs of fish with known passage histories. These include transported and bypassed fish, fish detected migrating the year following release (holdover fish), and fish tagged and transported from Lower Granite Dam during September and October (fall transport fish from the 2002 study year only).

From August to November 2006, we recovered no age-5-ocean and 23 age-4-ocean fall Chinook salmon adults, completing adult returns from smolts tagged during the 2001 and 2002 study years.

Fall Chinook Salmon Tagged as Juveniles in 2001

Based on all 2001 returns combined (jacks through age-5-ocean fish), the SAR of fish transported from Lower Granite Dam was 0.23% (95% CI, 0.16-0.30%), while that of fish bypassed at each dam at which they were detected was 0.28% (95% CI, 0.01-0.56%). The complex juvenile life history of these fish includes migration during the winter and following spring. From the 2001 study year, 614 juveniles were detected migrating in spring 2002, and the SAR for these fish was 7.00% (95% CI, 4.91-9.10%).

Conversion rates (the percentage of adults that successfully migrated from Bonneville Dam to Lower Granite Dam) varied for adults from the 2001 study year. Overall conversion rates from the 2001 study year were 59% for fish transported from

Lower Granite, 100% for fish bypassed at dams, and 85% for fish detected the following spring. These rates were not adjusted for any take in the Zone 6 fishery. For these same three groups, respective median travel times from Bonneville Dam to Lower Granite Dam were 14, 12, and 13 d. Because of the small numbers of adults, it was hard to determine differences between age classes either in conversion rates or median travel times.

Fall Chinook Salmon Tagged as Juveniles in 2002

Based on results from 2001 marking, we expect few or no age-5-ocean adults to return from the 2002 marking year. Therefore, with the age-4-ocean adult returns, this report provides the final analyses for transport studies of fall Chinook salmon tagged in 2002. Based on all 2002 returns combined (jacks through age-4-ocean fish), the SAR of fish transported from Lower Granite Dam was 0.98% (95% CI, 0.81-1.16%), while the SAR of fish bypassed at each dam at which they were detected was 0.66% (95% CI, 0.38-0.94%). From the 2002 study year, the 1,219 juveniles detected migrating in spring 2003 had an SAR of 5.58% (95% CI, 4.25-6.90%). During September and October 2002, we tagged an additional group of river-run subyearlings at Lower Granite Dam. These fish were placed in a truck with the rest of the fish collected at the dam and transported to below Bonneville Dam as part of the general transportation program. The SAR for this group was 4.88% (95% CI, 4.25-5.75%).

Overall conversion rates from the 2002 study year were 70% for fish transported from Lower Granite Dam, 78% for fish bypassed at all dams, 71% for fish detected migrating in spring 2003, and 51% for fish tagged and transported in fall. These numbers were not adjusted for any take in the Zone 6 fishery. Respective median travel times from Bonneville to Lower Granite Dam were 13, 12, 11, and 13 d for these same four groups. Among age classes, the age-2-ocean adults had the highest conversion rates and shortest travel time from Bonneville to Lower Granite Dam.

Smolt-to-adult returns from our 2001 and 2002 releases support the conclusion of Williams et al. (2005) that “transportation appeared to neither greatly harm nor help” Snake River fall Chinook salmon based on a comparison of transported and bypassed groups. The transported group had slightly lower SARs than the bypassed group in 2001, but slightly higher SARs in 2002, although confidence intervals overlapped for the two groups in both years. In both years, the highest SARs were seen in fish that delayed migration and in the late fall transport group from 2002. Each of these groups had juveniles that were much larger at the time of migration.

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INTRODUCTION

In 2006, we continued studies to evaluate transportation of juvenile salmonids as a means to mitigate for downstream losses that result from the lower Snake and Columbia River federal hydropower system. The primary objective of this study is to compare smolt-to-adult return rates (SARs) of juvenile Snake River fall Chinook salmon transported as to a release site below Bonneville Dam to those of their cohorts allowed to migrate inriver. Detections of PIT-tagged smolts released for migration in-river also provide data for short-term survival estimates between the point of release and downstream dams (Muir et al. 2001).

During transportation study years 1995-1996 and 1998-1999, we PIT-tagged (Prentice et al. 1990) wild and hatchery spring/summer yearling Chinook salmon smolts at Lower Granite Dam to compare SARs of smolts either transported and released below Bonneville Dam or released to the tailrace of Lower Granite Dam to migrate inriver (Marsh et al. 1996, 1997, 2000). Migrating smolts detected at downstream dams were returned to the river to continue their migration.

However, in evaluating SARs from those years (and from fish PIT-tagged for other studies upstream from Lower Granite Dam during the same years), we found that smolts collected and bypassed at multiple dams during inriver migration often survived to adulthood at lower rates than those bypassed only at Lower Granite Dam. Furthermore, fish not detected at any dams (because they passed via spillways or turbines or were not detected in juvenile bypass facilities) usually returned at higher rates than fish bypassed at downstream collector dams (Williams et al. 2005).

Thus, in hindsight, study designs from 1995 through 1999 did not provide sufficient information to compare returns of nondetected and nontransported fish to those of fish that were transported. We therefore redesigned the study in 2000 to compare SARs of transported fish to those of inriver migrants with no detection history at collector dams.

Our original design for fall Chinook salmon transport studies was to compare SARs of fish transported from Lower Granite Dam with those of fish that were not detected at any collector dam. However, recent data (Conner et al. 2005) has shown that the model used to estimate numbers of nondetected spring migrants (Sanford and Smith 2002) is not appropriate for estimates of nondetected Snake River fall Chinook salmon. A critical assumption of the model used to estimate juvenile survival is violated when some fall Chinook delay downstream migration (Buchanan and Skalski 2006). Estimates of juvenile survival based on this model consider the joint probability of migration and survival; however, for fall Chinook salmon, the probability of migration is unknown. These juveniles may migrate throughout the year, but detection systems at the dams are not operated year-round; fish that migrate when detection systems are down have no probability of detection, thus no data on migration probability is available (Buchanan and Skalski 2006).

Because at present there is no method to estimate the number of nondetected fall Chinook salmon, we report SARs of these fish only for those with known passage histories. These include transport, bypass, detection during migration in the year following release (holdover fish), and fall transport (i.e., fish tagged at and transported from Lower Granite Dam during September and October 2002).

The more complex life history of Snake River fall Chinook salmon also limits our ability to make estimates of differential delayed mortality (D). Furthermore, insufficient data is available to estimate survival to the tailrace of Bonneville Dam for Snake River fall Chinook, which is needed to estimate D. For these reasons, we do not estimate differential delayed mortality for fall Chinook salmon.

Here we report final results from the 2001 and 2002 Snake River fall Chinook salmon tagging years, which were completed with the recovery of adults in 2006. Information from ongoing adult returns of fall Chinook salmon tagged in 2004 and 2005 is also provided here (Appendix C). Adult returns are not yet available for Snake River fall Chinook salmon smolts PIT-tagged for transport studies during 2006. Data from these returns will be appended to annual fall Chinook transportation study reports beginning in 2007, and results will be reported in full when adult returns are complete in 2010.

MIGRATION YEAR 2001

Methods

In 2001, wild Snake River fall Chinook salmon juveniles were not available in sufficient numbers for tagging to evaluate transportation strategies. Therefore, we used hatchery fish as surrogates for this study year. Previous reach survival studies (Smith et al. 2002) have shown that performance of hatchery subyearling fall Chinook salmon is similar to that of wild fish if they are raised to the same size as wild fish. Therefore, our study used hatchery fish from Lyons Ferry Hatchery, located on the Snake River between Little Goose and Lower Monumental Dams. Study fish were raised to a smaller size than the general population of hatchery production fish.

In both 2001 and 2002, fish were PIT tagged in a mobile tagging trailer set up at the end of the raceway containing the study fish. Dip nets were used to transfer fish from the end of the raceway to a live well in the trailer. Fish were then sorted to remove fish that were too small or showed signs of disease or other conditions that would have reduced their post-tagging survival. After sorting, fish were sent to tagging stations, where each fish was injected with a PIT tag and measured (fork length). Any unusual body conditions were also noted at the time of tagging. Tagged fish were placed in gravity-fed pipes that led to an awaiting truck. At the end of the tagging session each day, fish were transported up the Snake River to Couse Creek (rkm 254), 81 km above Lower Granite Dam. Upon arrival at the release site, river water was slowly passed through the tank to gradually acclimate fish in order to avoid thermal shock from too great a temperature difference between tank and river water at release.

Juvenile Collection and Tagging

Study year 2001 was marked by near-record low flows in the Snake River. Because of this, we modified the original study design to exclude an inriver migrating cohort. We tagged only enough fish for a transport group (i.e., no non-detected group).

The number of PIT-tagged fish required for a transport index group at Lower Granite Dam was determined from the following equation:

$$N = (Z_{\alpha/2})^2 \times SAR \times (1\text{-}SAR)/w^2$$

where:

N = Number of PIT-tagged juveniles required for the transport group at Lower Granite Dam.
SAR = Expected smolt-to-adult return rate.
w = ½ width of a 95% confidence interval.

With $\alpha = 0.05$, $w = 0.002$ (0.2%), and an expected transport SAR of 0.01 (1.0%), then $N \approx 10{,}000$. Therefore, we needed to collect approximately 10,000 fish at Lower Granite Dam for the transport index group in spring 2001.

However, because fish were released upstream from Lower Granite Dam, a greater number of fish was required, since not all fish tagged and released could be collected at the dam. Based on PIT-tag detection rates and poor survival rates under low flow conditions, we assumed a survival rate to Lower Granite Dam of 25-30% for Lyons Ferry Hatchery subyearling Chinook, and a fish guidance efficiency (FGE) rate at the dam of 50%. Therefore, to collect the transport index group at Lower Granite Dam in 2001 required the release of roughly 75,000 PIT-tagged fish above the dam.

Inriver Migration

Marsh et al. (1996) provided details on how migrating PIT-tagged fish were tracked as they passed through the collection systems at dams along their migration corridor. No summer spill was provided in 2001, so all fish had to pass the dams via the bypass systems or through turbines. At all four collector dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams), fish detected on coils leading to the transport holding raceways were assumed to have been transported, while fish detected on diversion system coils were assumed to have been returned to the river.

Adult Recoveries and Data Analysis

In 2006, we completed the recovery of adults tagged as juveniles in 2001. The number of juvenile fish in the Lower Granite Dam transport group was the actual number of fish detected entering the raceways. By design, the number of fish tagged was insufficient to form a large enough group of non-detected fish with which to compare the SARs of transported fish.

Results

Juvenile Collection and Tagging

We PIT tagged 74,371 hatchery subyearling fall Chinook salmon from 18 to 26 May 2001 (Table 1 and Appendix Table A1). The number of fish tagged daily ranged from 5,305 to 11,652. Of the 74,371 fish tagged, 74,245 were released above Lower Granite Dam. Only thirteen fish died prior to release, but maximum holding time between tagging and release was only 10 h, not the 24 h commonly used to determine delayed mortality. We also found 113 lost tags prior to release.

Table 1. Tag date, numbers tagged, and mean fork lengths of fish PIT-tagged and released as part of the Snake River fall Chinook salmon transportation study, 2001.

	Lyons Ferry Hatchery Fall Chinook salmon		
Tag date	Tag number	Release number*	Mean fork length (mm)
5/18/01	5,305	5,293	81.2
5/19/01	8,395	8,385	82.8
5/20/01	8,643	8,620	82.9
5/21/01	10,606	10,577	84.1
5/22/01	11,652	11,629	84.3
5/24/01	11,370	11,337	84.6
5/25/01	11,575	11,538	85.6
5/26/01	6,867	6,866	89.5

* Release numbers adjusted for duplicates, mortality, and tag loss.

Inriver Migration

As study fish migrated seaward in 2001, some were detected at dams downstream from their release site. Of the 74,245 hatchery subyearling fall Chinook salmon tagged and released above Lower Granite Dam in 2001, 45,430 (61.2%) were never detected at a collector dam after release. Of the 28,815 (38.8%) fish that were detected, 18,904 were transported from Lower Granite Dam, 6,629 were transported from Little Goose Dam, 843 were transported from Lower Monumental Dam, 324 were transported from McNary Dam, 1,409 were detected and returned to the river at one or more collector dams, and the remaining 614 fish were detected migrating during spring 2002. (Table 2 and Appendix Tables A2-A5).

Table 2. Summary of detection histories (at collector dams) of PIT-tagged fall Chinook salmon smolts included in transportation evaluation, 2001. Holdovers are fish that were detected migrating in 2002.

	Detection History	Total number	Number of detections: First	Second	Third	Fourth
Not detected[a]	ND	45,430	--	--	--	--
Bypassed[b]	R	1,409	1,393	16	0	0
Transported from:						
Lower Granite Dam	T-Lgr	18,904	18,904	--	--	--
Little Goose Dam	T-Lgs	6,629	4,737	1,892	--	--
Lower Monumental Dam	T-Lmn	843	576	257	10	--
McNary Dam	T-Mcn	324	224	95	5	0
Unknown	U	92	42	47	3	0
Holdovers:						
Not detected[a]	H-ND	259	146	--	--	--
Bypassed[b]	H-R	331	216	99	11	0
Lower Granite Dam	H-T-Lgr	5	5	--	--	--
Little Goose Dam	H-T-Lgs	3	2	1	--	--
Lower Monumental Dam	H-T-Lmn	9	6	2	1	--
McNary Dam	H-T-Mcn	1	0	1	0	0
Unknown	H-U	6	2	4	0	0

[a] "Not detected" means not detected at a collector dam (Lower Granite, Little Goose, Lower Monumental, or McNary Dams). These fish could have been detected at other locations (Ice Harbor, John Day, or Bonneville Dams or the PIT trawl in the estuary or McNary Dam during the spring).

[b] "Bypassed" means returned to the river after being detected at one or more of the collector dams (Lower Granite, Little Goose, Lower Monumental, or McNary Dams during the summer and fall; Lower Granite, Little Goose, or Lower Monumental during the spring).

At Lower Granite, Little Goose and Lower Monumental Dams, our goal was to transport 80% of the subyearling Chinook salmon collected. The respective proportions of subyearling Chinook salmon collected at Lower Granite, Little Goose and Lower Monumental Dams and diverted for transportation were 83.8, 97.6 and 97.1%.

Adult Recoveries and Data Analysis

We began recovering jacks from the 2001 releases at Lower Granite Dam in 2002, and in November 2006, we completed recoveries from this release year with the collection of age-5-ocean adults. Returns by study group and age-class along with juvenile numbers are shown in Table 3.

SARs--With so few adult returns, it was difficult to discern any temporal patterns in SARs (Figure 1). However, we did observe the majority of adults returned from fish that passed Lower Granite Dam later in the year (Figure 2). Over 70% of the adult returns were derived from juveniles that passed Lower Granite Dam after the 70th percentile passage date (7 July 2001).

Table 3. Hatchery fall Chinook salmon returns by study group and age-class, with actual juvenile numbers for fish tagged at Lyons Ferry Hatchery and released above Lower Granite Dam in 2001.

Juvenile numbers	Returns by age-class: Jack	2-ocean	3-ocean	4-ocean	5-ocean	N	SAR%	95% C.I.
Transported from Lower Granite Dam								
18,904	19	13	10	1	0	43	0.23	0.16-0.30
Bypassed at collector dams								
1,409	1	2	0	1	0	4	0.28	0.01-0.56
All holdovers (transports and migrants)								
614	10	28	5	0	0	43	7.00	4.91-9.10

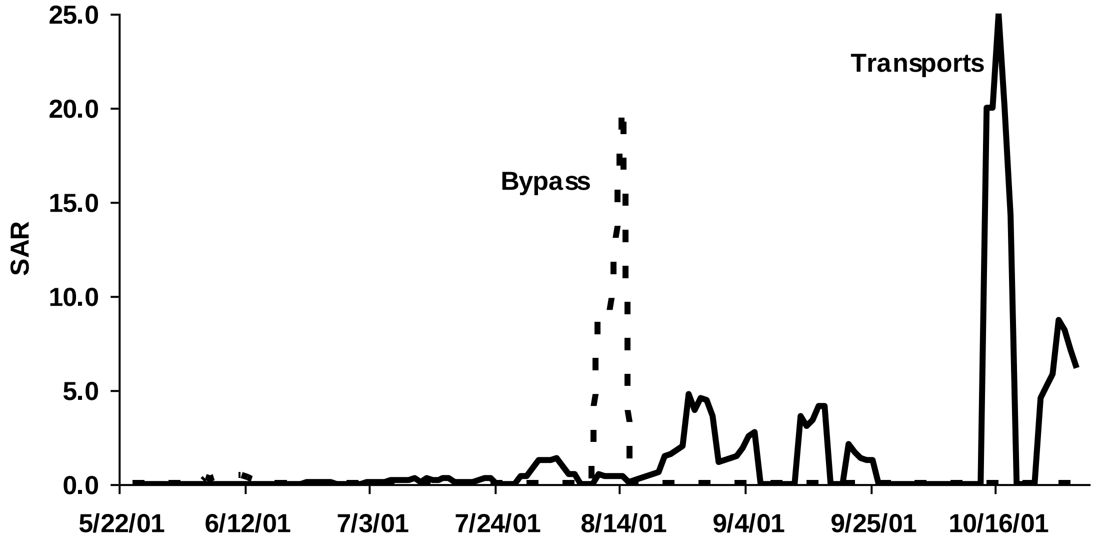

Figure 1. Smolt-to-adult return rates by passage date at Lower Granite Dam for subyearling Chinook smolts tagged in 2001 at Lyons Ferry Hatchery and released above Lower Granite Dam. Data are 5-day running averages of daily juvenile releases.

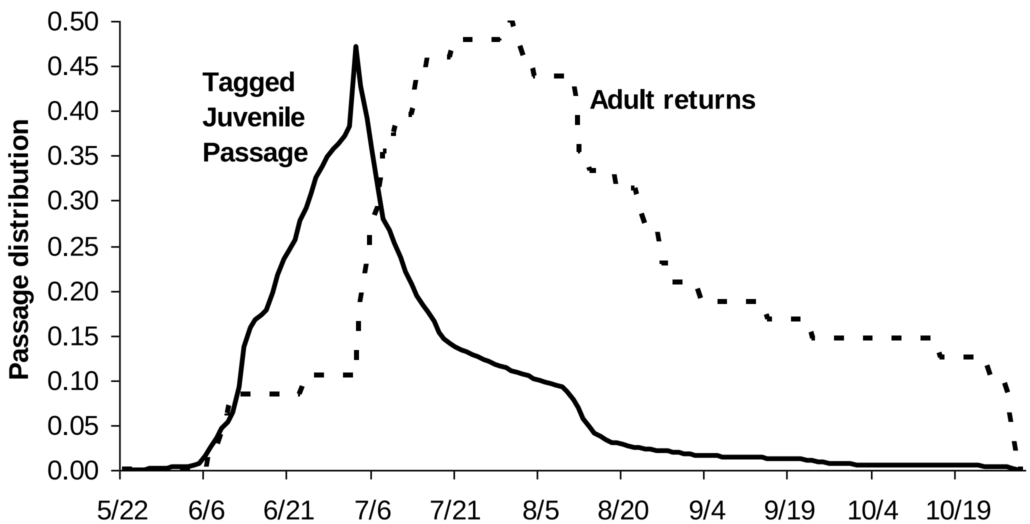

Figure 2. Juvenile subyearling Chinook salmon passage distribution at Lower Granite Dam and the adult return distribution based on when each adult passed Lower Granite Dam as a juvenile in 2001.

Conversion rates--Overall adult conversion rates from Bonneville Dam to Lower Granite Dam were lower for fish transported from Lower Granite Dam as juveniles (59.3%) than for fish bypassed as juveniles (100%) (Table 4). Adults from juveniles that did not migrate until spring 2002 had an overall conversion rate of 85.3%. There were no consistent differences in conversion rates between the Bonneville Dam to McNary Dam and McNary Dam to Lower Granite Dam reaches (Table 5).

To evaluate the conversion rate of adults transported as juveniles, we looked at straying and age-class differences. We found that jacks generally had the lowest conversion rates among transported adults of each age-class. In transported fish, the conversion rate for jacks was only 57.1%, compared to over 66.7% for age-2 and 60.0% for age-3-ocean adults.

Table 4. Percentage of adult fall Chinook salmon PIT-tagged in 2001 that were observed at Bonneville Dam and subsequently detected at Lower Granite Dam (the conversion rate).

	Number seen at Bonneville Dam	Number seen at Lower Granite Dam	Conversion rate
	Jacks		
Bypass	1	1	100.0
Transport	21	12	57.1
Holdover	10	7	70.0
	Age-2-ocean adults		
Bypass	1	1	100.0
Transport	15	10	66.7
Holdover	19	18	94.7
	Age-3-ocean adults		
Bypass	0	0	--
Transport	15	9	60.0
Holdover	5	4	80.0
	Age-4-ocean adults		
Bypass	1	1	100.0
Transport	3	1	33.3
Holdover	0	0	--
	Totals		
Bypass	3	3	100.0
Transport	54	32	59.3
Holdover	34	29	85.3

Table 5. Adult conversion rate (percent) from Bonneville Dam to McNary Dam and from McNary Dam to Lower Granite Dam for hatchery fall Chinook salmon PIT-tagged at Lyons Ferry Hatchery and released above Lower Granite Dam in 2001. (No adjustment for Zone 6 harvest)

	Bonneville Dam to McNary Dam			McNary Dam to Lower Granite Dam		
Migration history	Seen at Bonneville (n)	Subsequently seen at McNary (n)	Conversion rate	Seen at McNary (n)	Subsequently seen at Lower Granite (n)	Conversion rate
			Jacks			
Bypass	1	1	100.0	1	1	100.0
Transport	21	17	81.0	28	19	67.9
Holdover	10	7	70.0	9	8	88.9
			Age-2-ocean			
Bypass	1	1	100.0	3	3	100.0
Transport	15	11	73.3	14	13	92.9
Holdover	19	18	94.7	22	22	100.0
			Age-3-ocean			
Bypass	0	0	--	0	0	--
Transport	15	10	66.7	11	10	90.9
Holdover	5	4	80.0	4	4	100.0
			Age-4-ocean			
Bypass	1	1	100.0	1	1	100.0
Transport	3	1	33.3	1	1	100.0
Holdover	0	0	--	0	0	--
			Totals			
Bypass	3	3	100.0	5	5	100.0
Transport	54	39	72.2	54	43	79.6
Holdover	34	29	85.3	35	34	97.1

Since jacks constituted over 44% of the total returns of transported fish, their lower conversion rate heavily influenced the overall conversion rate for the transport group. We do not know whether these jacks passed Ice Harbor Dam or were lost prior to reaching the dam because there were no detectors in the ladders of Ice Harbor Dam until 2003, the year after these jacks returned.

We also looked at median travel time as a possible reason for the differences in conversion rates. However, in the median travel times for all age classes combined, we found a range of only 2 d among the three groups, with 12 d for the bypass group and 14 d for the transport group (Table 6). We do not believe this difference would explain the differences in conversion rates.

Table 6. Travel times from Bonneville Dam to Lower Granite Dam for adult fall Chinook salmon PIT-tagged as juveniles in 2001.

Age class	Migration history	Number of adults	Travel time from Bonneville Dam to Lower Granite Dam (d)
Jacks	Bypass	1	11.0
	Transport	12	14.0
	Holdover	7	13.0
Age-2-ocean	Bypass	1	16.0
	Transport	10	16.0
	Holdover	18	12.5
Age-3-ocean	Bypass	0	--
	Transport	9	13.0
	Holdover	4	11.5
Age-4-ocean	Bypass	1	12.0
	Transport	1	22.0
	Holdover	0	--
Totals	Bypass	3	12.0
	Transport	32	14.0
	Holdover	29	13.0

MIGRATION YEAR 2002

Methods

Juvenile Collection and Tagging

To determine release-group sizes in 2002, we calculated the number of fish required to test a null hypothesis, that there was no difference between the SARs of transported and migrant fish, vs. the alternative hypothesis, that the T/I ratio was 1.4 or greater. For a given type I error rate ($t_{\alpha/2}$, rejection of a true null hypothesis) and type II error rate (t_{β}, acceptance of a false null hypothesis), the number of fish needed for tagging was determined as:

$$\ln\left(\frac{\mathrm{T}}{\mathrm{I}}\right) - \left(t_{\frac{\alpha}{2}} + t_{\beta}\right) \times \mathrm{SE}\left(\ln\left(\frac{\mathrm{T}}{\mathrm{I}}\right)\right) \approx 0 \tag{1}$$

and

$$\mathrm{SE}\left(\ln\frac{\mathrm{T}}{\mathrm{I}}\right) = \sqrt{\left(\frac{1}{\mathrm{n_T}} + \frac{1}{\mathrm{n_I}}\right)} = \sqrt{\frac{2}{\mathrm{n}}} \tag{2}$$

where n is the number of adult returns per treatment (for either n_T transport or n_I migrant groups). The previous two statements imply that the sample of adults needed is:

$$\mathrm{n} = \frac{2\left(\mathrm{t}_{\frac{\alpha}{2}} + \mathrm{t}_{\beta}\right)^2}{\left(\ln\left(\frac{\mathrm{T}}{\mathrm{I}}\right)\right)^2} \tag{3}$$

Therefore, if α = 0.05 and β = 0.20, and if we wished to discern a difference of 100% (T/I = 2.0), and we expected a transport SAR of at least 1.0% for each species, the sample sizes needed at Lower Granite Dam were:

n =	34
N_T =	3,400
N_I =	6,800
Total juveniles =	10,200

Where N_T is the number of juveniles needed for the transport cohort and N_I is the number of fish needed for the migrating cohort (3,400 × 2.0).

However, because we released fish upstream from Lower Granite Dam, at Lyons Ferry Hatchery, a release number greater than N_I was needed. This is because not all fish released above the dam will surivive to reach the dam, and of those that reach the dam, not all will be collected. Therefore, based on previous estimates from PIT tag detections, we assumed 60% survival to Lower Granite Dam and an FGE of 50% at the dam. Thus to obtain N_I of 6,800 required the release of approximately 22,750 fish above the dam.

Based upon previous PIT-tag detections, we estimated that 15-30% of the subyearling Chinook salmon that passed Lower Granite Dam without being detected would never be subsequently detected at any Snake River collector dam downstream. Therefore, to provide an adequate number of never-detected inriver-migrant fish below Lower Granite Dam required releasing roughly 150,000 (22,712/0.15) PIT-tagged fish above the dam. This also provided numbers of transport test fish collected at Lower Granite Dam well in excess of study design requirements. We decided to return the excess fish collected at Lower Granite Dam back to the river to measure in-river survival to below John Day Dam. At the time, we believed this would allow us to begin the process for calculating post-transport delayed mortality.

Inriver Migration

Some summer spill was provided in 2002. At all four collector dams (Lower Granite, Little Goose, Lower Monumental, and McNary Dams), fish detected on coils leading to the raceways were assumed to have been transported, while fish detected on diversion system coils were assumed to have been returned to the river.

Adult Recoveries and Data Analysis

In 2006, we completed the recovery of age-4-ocean adults tagged as juveniles in 2002. We expect very few if any age-5-ocean adults (none returned from 2001 releases) from tagging in 2002. Therefore, we completed the analyses for 2002 releases of fall Chinook salmon for transportation studies after these age-4-ocean adults returned. The number of juvenile fish in the Lower Granite Dam transport group, N_T, was the actual number of fish detected entering the transportation loading raceways.

Results

Juvenile Collection and Tagging

We PIT tagged 98,335 hatchery subyearling fall Chinook salmon from 29 May to 14 June 2002 (Table 7 and Appendix Tables B1 and B2). The number of fish tagged daily ranged from 4,736 to 12,725. Of the 98,335 fish tagged, 97,916 were released above Lower Granite Dam.

We were unable to meet our goal of tagging 150,000 fish due to an outbreak of bacterial gill disease at Lyons Ferry Hatchery during winter 2001-2002. This outbreak (and subsequent treatment) resulted in stunted growth of the fish designated for this study. Even with the growth that occurred over the 3 weeks of tagging, we were forced to sort and cull through the fish at least twice to obtain the 98,335 fish we tagged. Of the fish we PIT-tagged, only 38 died prior to release, but maximum holding time between tagging and release was only 10 h, not the 24 h commonly used to determine delayed mortality. We also found 60 lost tags prior to release.

Table 7. Tag date, numbers tagged, and mean fork lengths of fish PIT-tagged and released as part of the Snake River fall Chinook salmon transportation study, 2002.

	Lyons Ferry Hatchery Fall Chinook salmon		
Tag date	Tag number	Release number*	Mean fork length (mm)
5/29/2002	4,736	4,723	67.0
5/30/2002	5,885	5,885	68.6
5/31/2002	5,464	5,464	69.0
6/3/2002	6,698	6,698	67.9
6/4/2002	5,141	5,141	70.0
6/5/2002	7,202	7,201	67.6
6/6/2002	10,062	10,062	67.3
6/7/2002	8,933	8,933	69.2
6/10/2002	9,039	9,023	69.6
6/11/2002	7,245	7,239	70.6
6/12/2002	8,727	8,706	68.2
6/13/2002	12,725	12,703	67.7
6/14/2002	6,157	6,138	68.4

* Release numbers adjusted for mortality and tag loss.

In addition to the fish tagged at Lyons Ferry, we PIT-tagged river-run subyearlings at Lower Granite Dam in September and October 2002 (Table 8 and Appendix Tables B1 and B2). These fish were taken from the daily smolt monitoring sample. After tagging, we placed fish with the general population collected at the facility for transport by truck to a release site below Bonneville Dam. We observed no mortality or tag loss from these fish, although post-tagging holding time was very short (< 1 h). The purpose of this group was to bolster the number of fish transported later in the season to increase precision of the SAR for fish migrating as juveniles during this time of year.

Table 8. Tag date, numbers tagged, and mean fork lengths of fish PIT-tagged at and transported from Lower Granite Dam as part of the Snake River fall Chinook salmon transportation study, 2002.

	Lower Granite Dam Fall Chinook salmon	
Tag date	Tag number	Mean fork length (mm)
9/5/02	103	165.4
9/6/02	101	166.5
9/11/02	155	168.1
9/13/02	131	169.5
9/17/02	101	176.8
9/18/02	81	176.0
9/19/02	101	174.8
9/21/02	82	177.7
9/25/02	145	175.6
9/27/02	177	180.5
10/1/02	84	179.7
10/3/02	162	182.3
10/5/02	86	181.6
10/9/02	162	181.9
10/11/02	166	183.1
10/15/02	57	182.8
10/17/02	114	182.7
10/23/02	164	181.0
10/25/02	162	184.5
10/29/02	171	177.3

Inriver Migration

As study fish migrated seaward in 2002, 23.2% were detected at dams downstream from their release site. Of the 97,916 hatchery subyearling fall Chinook salmon tagged and released above Lower Granite Dam, 75,235 (76.8%) were never detected at a collector dam after release. Of the 22,681 (23.2%) fish that were detected, 12,315 were transported from Lower Granite Dam, 3,979 were transported from Little Goose Dam, 1,845 were transported from Lower Monumental Dam, 60 were transported from McNary Dam, 3,201 were detected and returned to the river at one or more collector dams, 115 were detected as subyearlings during summer and fall of 2002 and subsequently detected as yearlings during spring 2003, and the remaining 1,104 fish were only detected migrating during the spring of 2003. (Table 9 and Appendix Tables B3-B6).

At Lower Granite, Little Goose and Lower Monumental Dams, our goal was to transport 80% of the subyearling Chinook salmon collected. The respective proportions of subyearling Chinook salmon collected at Lower Granite, Little Goose and Lower Monumental Dams and diverted for transportation were 80.7, 79.0 and 78.6%.

Table 9. Summary of detection histories of PIT-tagged fall Chinook salmon smolts included in transportation evaluation, 2002.

	Detection history	Total number	Number of detections: First	Second	Third	Fourth
Not detected[a]	ND	75,235	--	--	--	--
Bypassed[b]	R	3,201	2,699	444	55	3
Transported from:						
Lower Granite Dam	T-Lgr	12,315	12,315	--	--	--
Little Goose Dam	T-Lgs	3,979	3,140	839	--	--
Lower Monumental Dam	T-Lmn	1,845	1,365	432	48	--
McNary Dam	T-Mcn	60	27	26	7	0
Unknown	U	62	46	16	0	0
Tagged in Sep/Oct at & Tran from LGR	Fall-T	2,500	2,500	--	--	--
Holdovers:						
Not detecteda	H-ND	548	443	96	9	--
Bypassed[b]	H-R	501	376	119	6	0
Bypassed[b]	H-R2[c]	115	36	77	2	0
Lower Granite Dam	H-T-Lgr	15	15	--	--	--
Little Goose Dam	H-T-Lgs	26	23	3	--	--
Lower Monumental Dam	H-T-Lmn	12	10	2	0	--
McNary Dam	H-T-Mcn	1	1	0	0	0
Unknown	H-U	1	0	1	0	0

a "Not detected" means not detected at a collector dam (Lower Granite, Little Goose, Lower Monumental, or McNary Dams). These fish could have been detected at other locations (Ice Harbor, John Day, or Bonneville Dams or the PIT trawl in the estuary or McNary Dam during the spring).

b "Bypassed" means returned to the river after being detected at one or more of the collector dams (Lower Granite, Little Goose, Lower Monumental, or McNary Dams during the summer and fall; Lower Granite, Little Goose, or Lower Monumental during the spring).

c These fish were detected at one or more of the collector dams (Lower Granite, Little Goose, Lower Monumental, or McNary Dams) as subyearlings during summer and fall 2002, and detected again as yearlings during spring 2003.

Adult Recoveries and Data Analysis

We began recovering jacks from the 2002 releases at Lower Granite Dam in 2003, and in November 2006, we completed recoveries from this release year with the collection of age-4-ocean adults. Because very few if any age-5-ocean adults return, we decided to end the study after all the age-4-ocean adults were back. Returns by study group and age-class are shown in Table 10, with actual juvenile numbers.

SARs--We observed that SARs increased for both transported and bypassed fish as the season progressed (Figure 3). As was observed in 2001, the majority of adults returned from fish that passed Lower Granite Dam later in the year (Figure 4). Over 65% of the adult returns were derived from juveniles that passed Lower Granite Dam after the 70% percentile passage date (26 July 2002).

SARs ranged from 2.0% to nearly 8.0% for river-run fall Chinook salmon tagged at Lower Granite Dam during September and October 2002 (Figure 5). Overall, SARs were fairly flat for the entire fall period.

Table 10. Hatchery fall Chinook salmon returns by study group and age-class, with actual juvenile numbers released for transport studies in 2002.

	Returns by age-class						
Juvenile numbers	Jack	2-ocean	3-ocean	4-ocean	5-ocean	SAR (%)	95% CI
	Transported from Lower Granite Dam						
12,315	34	55	24	8	-	0.98	(0.81-1.16)
	Bypassed at collector dams						
3,201	9	11	1	0	-	0.66	(0.38-0.94)
	Tagged and transported from Lower Granite Dam, Fall 2002						
2,500	42	47	24	9	-	4.88	(4.01-5.75)
	All holdovers (transports and migrants)						
1,219	13	42	12	1	-	5.58	(4.25-6.90)

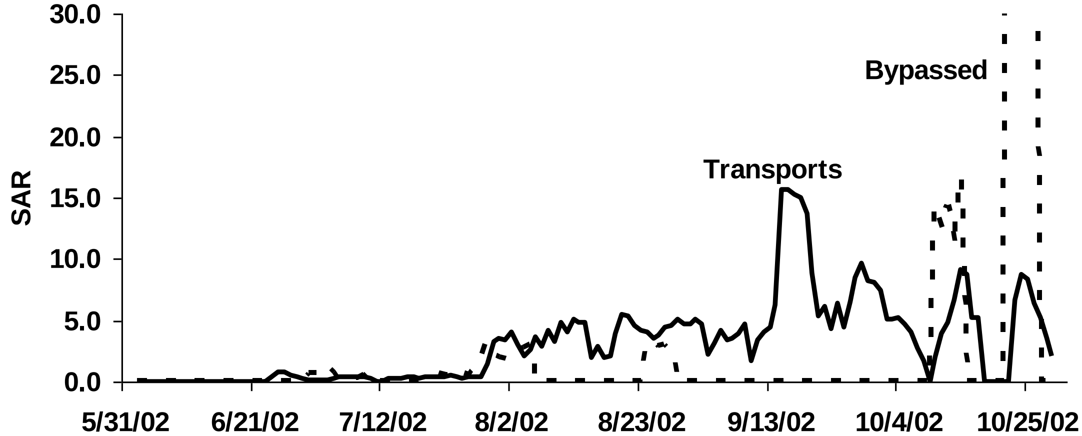

Figure 3. Smolt-to-adult return rates by passage date at Lower Granite Dam for subyearling Chinook smolts tagged in 2002 at Lyons Ferry Hatchery and released above Lower Granite Dam. Data are 5-day running averages of daily juvenile releases. Bypassed SARs that rise off the chart reached 50-100%.

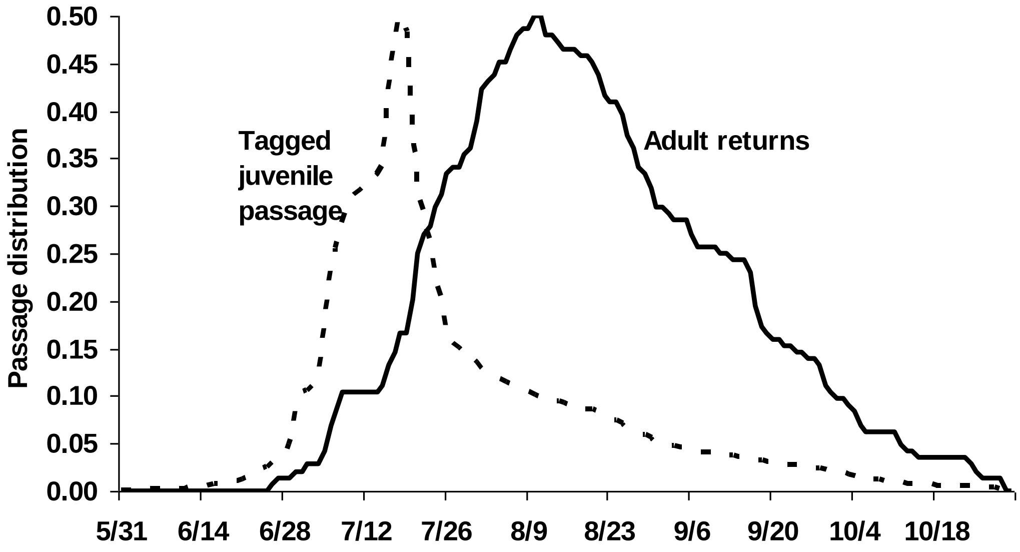

Figure 4. Juvenile subyearling Chinook salmon passage distribution at Lower Granite Dam and the adult return distribution based on when each adult passed Lower Granite Dam as a juvenile in 2002.

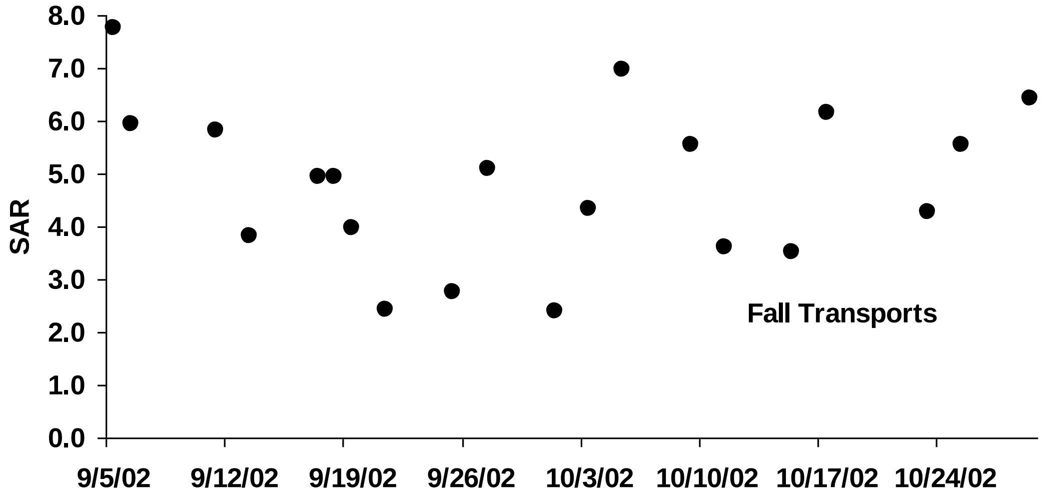

Figure 5. Smolt-to-adult return rates by tag date for run-of-the-river subyearling Chinook smolts tagged in fall 2002 at Lower Granite Dam and transported by truck to below Bonneville Dam. Data are daily SARs.

Conversion rates--Overall adult conversion rates (not adjusted for Zone 6 fishery) from Bonneville Dam to Lower Granite Dam ranged from 78.4% (bypass group) to 51.0% (fall transport group), with both the transport and holdover groups around 70% (Table 11). The fall transport group had the poorest conversion rate of any group of fish recorded in our transport studies. Age-4-ocean adults had the lowest conversion rate overall, while age-2-ocean adults had the highest conversion rate. When we looked at the conversion rates for the different reaches (Table 12), we saw that, with the exception of the fall transport group, all groups converted at a higher rate between McNary and Lower Granite Dams, with the bypass and holdover groups doing better than the transport group.

Conversion rates between Bonneville and McNary Dams was highest for the bypass and transport groups with the lowest group being the fall transport group. When we looked at the conversion rate for fall transport adults from McNary Dam to Ice Harbor Dam, we found that two groups, transport (93.6%) and fall transport (82.1%), did not have 100% conversion between these two dams. Of the four groups, only fall transport adults (85.5%) did not covert over 91% between Ice Harbor and Lower Granite Dams.

Table 11. Percentage of adult spring/summer Chinook salmon PIT-tagged in 2002 that were observed at Bonneville Dam and subsequently detected at Lower Granite Dam (the conversion rate).

Adult age class	Migration istory	Number seen at Bonneville Dam	Number seen at Lower Granite Dam	Conversion rate
Jacks	Bypass	11	10	90.9
	Transport	31	20	64.5
	Holdover	10	7	70.0
	Fall transport	58	31	53.5
Age-2-ocean	Bypass	17	13	76.5
	Transport	63	49	77.8
	Holdover	31	27	87.1
	Fall transport	65	41	63.1
Age-3-ocean	Bypass	7	4	57.1
	Transport	38	24	63.2
	Holdover	22	12	54.6
	Fall transport	56	24	42.9
Age-4-ocean	Bypass	2	2	100.0
	Transport	13	8	61.5
	Holdover	3	1	33.3
	Fall transport	27	9	33.3
Totals	Bypass	37	29	78.4
	Transport	145	101	69.7
	Holdover	66	47	71.2
	Fall transport	206	105	51.0

Table 12. Adult conversion rate (percent) from Bonneville Dam to McNary Dam and from McNary Dam to Lower Granite Dam for hatchery fall Chinook salmon PIT-tagged and released during transport studies in 2002. (No adjustment for Zone 6 harvest.)

	Bonneville Dam to McNary Dam			McNary Dam to Lower Granite Dam		
Migration history	Seen at Bonneville (n)	Subsequently seen at McNary (n)	Conversion rate	Seen at McNary (n)	Subsequently seen at Lower Granite (n)	Conversion rate
			Jacks			
Bypass	11	11	100.0	13	12	92.3
Transport	31	27	87.1	41	33	80.5
Holdover	10	8	80.0	14	13	92.9
Fall Tran	58	41	70.7	55	37	67.3
			Age-2-ocean			
Bypass	17	14	82.4	16	15	93.8
Transport	63	58	95.1	64	55	85.9
Holdover	31	27	87.1	42	42	100.0
Fall Tran	65	60	92.3	69	47	68.1
			Age-3-ocean			
Bypass	7	4	57.1	4	4	100.0
Transport	38	27	71.1	27	24	88.9
Holdover	22	12	59.1	13	12	92.3
Fall Tran	56	34	60.7	34	24	70.6
			Age-4-ocean			
Bypass	2	2	100.0	2	2	100.0
Transport	13	8	61.5	8	8	100.0
Holdover	3	2	66.7	2	1	50.0
Fall Tran	27	10	37.0	10	9	90.0
			Totals			
Bypass	37	31	83.8	35	33	94.3
Transport	145	120	82.8	140	120	85.7
Holdover	66	50	75.8	71	68	95.8
Fall Tran	206	145	70.4	168	117	69.6

To understand the lower conversion rate of fall transport adults, we looked at straying and age-class differences. We found age-2-ocean adults had the best conversion rate for this group of adults, but it was only 63.1%, while age-4-ocean adults had the lowest rate, 33.3%. When we looked for straying, we found that one age-2-ocean adult and one age-3-ocean adult did stray above Priest Rapids Dam, and the age-2-ocean adult even passed Rock Island Dam. Both of these adults were from the fall transport group and neither was detected at Ice Harbor or Lower Granite Dams.

We also looked at median travel time as a possible reason for the differences in conversion rates. However, the total median travel times of the four groups (all age classes combined) ranged from 11 d for the holdover group to 13 d for transport and fall transport groups (Table 13). We do not believe that a difference of only 2 d would explain the differences in conversion rates.

Table 13. Travel times from Bonneville Dam to Lower Granite Dam for adult fall Chinook salmon PIT-tagged as juveniles in 2002.

Age class	Migration history	Travel time from Bonneville Dam to Lower Granite Dam (d)
Jacks	Bypass	14.0
	Transport	15.0
	Holdover	13.0
	Fall transport	14.0
Age-2-ocean	Bypass	11.0
	Transport	12.0
	Holdover	11.0
	Fall transport	11.0
Age-3-ocean	Bypass	13.0
	Transport	12.0
	Holdover	11.0
	Fall transport	11.5
Age-4-ocean	Bypass	14.5
	Transport	12.5
	Holdover	13.0
	Fall transport	15.0
Totals	Bypass	12.0
	Transport	13.0
	Holdover	11.0
	Fall transport	13.0

Length at tagging--Transport and fall transport adults showed decreasing fork length at tagging with increasing age of adults (Table 14). Bypassed fish, if we excluded jacks, also showed this trend. Holdovers showed no trend when age of adult return was compared to fork length at juvenile tagging. We also observed that, excluding age-2-ocean adults (when they were the largest), bypass adults were the smallest at tagging of all the groups.

Table 14. Average tagging lengths of adult hatchery fall Chinook salmon PIT-tagged as juveniles at Lyons Ferry Hatchery in 2002.

Adult age class		Number of adults	Average length as juveniles at tagging (mm)
Jacks	Bypass	12	66.6
	Transport	34	69.0
	Holdover	12	68.7
	Fall transport	42	185.5
Age-2-ocean	Bypass	15	69.1
	Transport	55	68.8
	Holdover	41	68.0
	Fall transport	47	178.9
Age-3-ocean	Bypass	4	67.5
	Transport	23	68.5
	Holdover	12	68.8
	Fall transport	24	175.2
Age-4-ocean	Bypass	2	64.0
	Transport	8	65.4
	Holdover	1	66.0
	Fall transport	9	174.6

DISCUSSION

We began Snake River fall Chinook salmon transportation studies in 2001 believing this group of fish had similar migration behavior as spring migrants, i.e., they completed their migration to the ocean the year they were tagged and released. Based on this assumption, we designed the study for fall Chinook salmon similar to those for spring migrants (Marsh et al. 1997, 2000, 2001, 2004b, 2005, 2006). That is, we released a transport group of juvenile subyearling Chinook and compared SARs from that group to those of their "non-detected" cohorts, or those that migrated as juveniles without being detected at a collector dam (i.e., a dam with transportation facilities, meaning Lower Granite, Little Goose, Lower Monumental, or McNary Dam).

We originally intended to use the methods of Sandford and Smith (2002) to estimate the number of juveniles in “non-detected” migrant groups of fall Chinook transport studies from 2001 to 2004 (Marsh et al. 2003, 2004a). Since fall Chinook salmon can return as adults up to 5 years after entering the ocean, adult returns of these fish would be completed from 2006 to 2009.

However, as we began to observe adult returns from the 2001-2004 releases, we obtained new information about Snake River fall Chinook salmon behavior and complex life history strategies. As far as our study design was concerned, the most important piece of new information was the fact that Snake River fall Chinook salmon migrate year-round, often stopping for months at a time before moving farther downstream (Connor et al. 2005). The consequence of this behavior is that we cannot distinguish between the probabilities of detection, mortality, and delayed migration in the non-detected fish group. Therefore, a transportation study of Snake River fall Chinook salmon cannot be based on a study design appropriate for evaluation of transportation of spring migrants (spring/summer Chinook salmon and steelhead) (Buchanan and Skalski 2006).

For example, a basic assumption of the model that estimates the number of fish that arrived at Lower Granite Dam but were not detected (the non-detected group) is that all fish have equal probability of detection. However, Snake River fall Chinook salmon that pass detection sites during winter, when detection systems are shut down, have no chance of detection: thus a critical assumption of the model is violated. Unless or until we are able to determine the number of fish that migrate during this time period, we are unlikely to find appropriate adjustments to the model to produce reasonably accurate estimates.

Without the ability to reliably estimate the number of fish in the non-detected group, we can neither calculate nor estimate a reliable SAR for this group, nor can we compare SARs of this group to those of a transport group, as is commonly done in transportation evaluations of spring/summer Chinook salmon and steelhead.

To further complicate matters, we began noticing that subyearling Chinook that delayed migration through winter and were detected the following spring (after detection systems were watered up) were returning at much higher rates (18-30 times higher) than fish that migrated during summer the same year they were released. Thus, in addition to being unable to estimate the number of non-detected fish, which forms the inriver migrant group for comparsion, these same fish are adding disproportionately to the total number of returning adults. When we consider that adult returns of detected subyearlings are higher for fish that migrated as juveniles later in the year, our estimate of the total number of non-detected juvenile migrants is even less meaningful, since we lack any knowledge of juvenile migration timing for "non-detected" adults.

Despite these difficulties, we can still compare the SARs of fish returned to the river following detection at Lower Granite Dam to those of transported fish. Fish detected and bypassed are known to have passed during the transportation "window" at the dam. Thus, they provide a basis for comparison to fish collected and transported from the same dam. This comparison answers the important question, “What do I do with this fish now that I’ve collected it?” (i.e., whether to transport or not). However, it does not address other potential effects of transportation or other mitigation strategies (i.e., spill and RSWs) on the entire population, since it excludes the substantial number of fish that are never detected within the hydropower system.

In addition, it could be argued that detections of the bypass group at Lower Granite Dam do not constitute a fair data set for comparison with transported fish because we do not know whether these fish continued to migrate downstream after detection. We have evidence of the cessation of migration from our 2002 study year, where 115 fish were detected as subyearlings in 2002 and subsequently as yearlings in 2003. So far, these detections indicate only that fish may delay migration anywhere along the migration corridor. For example, one fish was detected as a subyearling at Lower Granite Dam in June 2002 and then as a yearling the following spring at Little Goose Dam; thus it remained in the upper Snake River for months after detection.

In response to this new information, we changed our study design in 2005 (Connor et al., in prep); however, for fish released during transport studies prior to the redesign (2001-2004), we can estimate SARs only for fish groups known to have passed

Lower Granite Dam. These include the transport group (transported from the dam), a "bypass" group (detected and bypassed at the dam), a fall transport group (in 2002 we began to supplement the number of subyearling Chinook transported in fall), and a "holdover" group (detected at or below the dam in the spring following release).

In estimating the number of juveniles needed for tagging to produce acccurate SARs, we assumed a collection rate of 15% at Lower Granite Dam in 2001 (25-30% survival × 50% FGE). Despite the near-record low flows experienced in 2001, we collected 30.4% of the fish released above the dam that year. With higher flows in 2002, we expected to collect 30% of the released fish (60% survival × 50% FGE); however, we collected only 15.6% of the fish released above Lower Granite Dam. We attribute the lower percentage collected in 2002 to the smaller size (length and weight) of fish tagged in 2002. This conclusion is supported by the observation that over twice as many fish from the 2002 marking held over during winter. Many of these fish were not ready to migrate at the time of tagging: they needed additional time to grow and improve their condition and so migrated the following spring.

Smolt-to-adult returns from our 2001 and 2002 releases did nothing to alter the conclusion of Williams et al. (2005), that “transportation appeared to neither greatly harm nor help” Snake River fall Chinook salmon based on a comparison of transported and bypassed groups. Transported fish had slightly lower SARs than bypassed fish in 2001, but slightly higher SARs than bypassed fish in 2002 (although confidence intervals between the two groups overlapped in both years). The highest SARs were observed in the holdover groups in both years and in the late fall transport group in 2002. Both of these groups were far larger than transported fish at the time of their migration.

The SAR of the 2002 transport group was over 400% of the SAR for the 2001 transport group, which is surprising given the difference in fish health and size between the two years. This likely indicates that interannual differences in estuary and ocean conditions have a stronger role in determining SARs than differences during rearing and freshwater residence. However, 2001 was also an extremely low flow year, and this was also likely to have affected SARs.

We expected that conversion rates from Bonneville Dam to Lower Granite Dam would be lower, in general, for fall Chinook salmon adults than for spring/summer Chinook salmon adults due to the higher harvest rate for fall Chinook salmon. However, we were surprised at the extremely low conversion rate of adults transported as juveniles in fall transport adults. One possible explanation is that because these fish started out larger at tagging, they also returned as larger fish, and were therefore more susceptible to gill and tangle nets used in the fishery.

During fall 2005 and 2006, returning adult fall Chinook from the 2002 transportation study year were captured as part of a life-history study (Marsh et al. 2007; in prep). Transportation study fish were diverted from the adult population using the separation-by-code PIT-tag diversion system (Marsh et al. 1999; Downing et al. 2001) at the Lower Granite Dam adult trap (Harmon 2003). Lengths of these returning adults (Table 15) supported the idea that fall transport adults are larger than the other groups.

One would expect that adults from the holdover group would also be larger adults because they were larger when they migrated as juveniles, and if ocean age was assigned based on time at sea, that would be the case. However, in transportation studies, we assign ocean age based on brood year. Therefore, adults that delayed migration until the spring following release have actually spent one less year at sea than their cohorts of the same age class.

Nevertheless, we continue to assign ages in this manner, and our reason for doing so is based on another surprising finding from the life history study: Analysis of scales taken from returning adults has shown that a large proportion of the fall transport group overwinters in freshwater areas below Bonneville Dam after being transported. These fish enter the ocean as yearlings, as do fish in the holdover group. If age assignment was based on time at sea instead of brood year, we would need two fall transport groups: one that entered the ocean as subyearlings and a second that entered as yearlings/holdovers. In fact, as Table 16 shows, all groups from the 2002 study have a mixture of subyearling and yearling ocean entrants, and would require this treatment. At present, we avoid confusion by continuing to assign ocean age based on brood year.

Table 15. Average lengths of adult hatchery fall Chinook salmon PIT-tagged as juveniles for transport studies in 2002 and re-captured at Lower Granite Dam during fall of 2005 (age-3-ocean) and fall 2006 (age-4-ocean).

Age class		Number of adults	Average length of returning adults at Lower Granite Dam (mm)
Age-3-ocean	Bypass	4	733.3
	Transport	23	739.3
	Holdover	12	712.5
	Fall transport	24	748.5
Age-4-ocean	Bypass	2	805.0
	Transport	8	840.0
	Holdover	1	820.0
	Fall transport	9	848.8

Table 16. Age at ocean entry for adult hatchery fall Chinook salmon PIT-tagged as juveniles at for transport studies in 2002 and re-captured at Lower Granite Dam during fall of 2005 (age-3-ocean) and fall 2006 (age-4-ocean).

		Age at ocean entry		
Age class		Subyearling	Yearling	Unknown
Age-3-ocean	Bypass	3	0	0
	Transport	7	5	3
	Holdover	0	8	0
	Fall transport	1	9	3
Age-4-ocean	Bypass	0	2	0
	Transport	3	3	0
	Holdover	0	1	0
	Fall transport	1	6	1

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REFERENCES

Buchanan, R. A. and J. R. Skalski. 2006. Design and analysis of salmonid tagging studies in the Columbia Basin, vol. XIX: analysis of fall Chinook salmon PIT-tag data: estimating transportation effects. Report of the University of Washington School of Aquatic and Fishery Sciences to the Bonneville Power Administration. Available www.efw.bpa.gov/searchpublications (December 2007).

Connor, W. P., B. D. Arnsberg, S. G. Smith, D. M. Marsh, W. D. Muir. In prep. Post-release performance of natural and hatchery fall Chinook salmon subyearlings released into the Snake and Clearwater Rivers. Annual report of research activities to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Connor, W. P., J. G. Sneva, K. F. Tiffan, R. K. Steinhorst, D. Ross. 2005. Two alternative juvenile life histories for fall Chinook salmon in the Snake River basin. Transactions of the American Fisheries Society 134:291-304.

Downing, S. L., E. F. Prentice, R. W. Frazier, J. E. Simonson, E. P. Nunnallee. 2001. Technology developed for diverting passive integrated transponder (PIT) tagged fish at hydroelectric dams in the Columbia River Basin. Aquacultural Engineering, 25:149-164.

Harmon, J. R. 2003. A trap for handling adult anadromous salmonids at Lower Granite Dam on the Snake River, Washington. North American Journal of Fisheries Management 23:989-992.

Marsh, D. M., J. R. Harmon, K. W. McIntyre, K. L. Thomas, N. N. Paasch, B. P. Sandford, D. J. Kamikawa, and G. M. Matthews. 1996. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1995. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, W. D. Muir, and W. P. Connor. In prep. A study to understand the early life history of Snake River Basin fall Chinook salmon, 2006. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, W. D. Muir, and W. P. Connor. 2007. A study to understand the early life history of Snake River Basin fall Chinook salmon, 2005. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 1997. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1996. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2000. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 1998. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2001. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 2000. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2003. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 2001. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2004a. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 2002. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2004b. Transportation of juvenile salmonids on the Columbia and Snake Rivers, 2003: final adult returns for wild yearling Chinook salmon migrating in 2000. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2005. Research related to transportation of juvenile salmonids on the Columbia and Snake Rivers, 2004: Final report for the 2001 spring/summer Chinook salmon juvenile migration. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., J. R. Harmon, N. N. Paasch, K. L. Thomas, K. W. McIntyre, B. P. Sandford, and G. M. Matthews. 2006. Research related to transportation of juvenile salmonids on the Snake River, 2005: Final report for the 2002 spring/summer Chinook salmon juvenile migration. Report of the National Marine Fisheries Service to the U.S. Army Corps of Engineers, Walla Walla, Washington.

Marsh, D. M., G. M. Matthews, S. Achord, T. E. Ruehle, and B. P. Sandford. 1999. Diversion of salmonid smolts tagged with passive integrated transponders from an untagged population passing through a juvenile collection system. North American Journal of Fisheries Management 19:1142-1146.

Muir, W. D., S. G. Smith, J. G. Williams, E. E. Hockersmith, and J. R. Skalski. 2001. Survival estimates for migrant yearling Chinook salmon and steelhead tagged with passive integrated transponders in the lower Snake and lower Columbia Rivers, 1993-1998. North American Journal of Fisheries Management 21:269-282.

Prentice, E. F., T. A. Flagg, and C. S. McCutcheon. 1990. Feasibility of using implantable passive integrated transponder (PIT) tags in salmonids. American Fisheries Society Symposium 7:317-322.

Sandford, B. P., and S. G. Smith. 2002. Estimation of smolt-to-adult return percentages for Snake River Basin anadromous salmonids, 1990-1997. Journal of Agricultural Biological, and Environmental Statistics 7:243-263.

Smith, S. G., W. D. Muir, J. G. Williams and J. R. Skalski. 2002. Factors associated with travel time and survival of migrant yearling chinook salmon and steelhead in the lower Snake River. North American Journal of Fisheries Management 22:385-405.

Williams, J. G., S. G. Smith, R. W. Zabel, W. D. Muir, M. D. Scheuerell, B. P. Sandford, D. M. Marsh, R. McNatt, and S. Achord. 2005. Effects of the federal Columbia River power system on salmon populations. NOAA Technical Memorandum NMFS-NWFSC-63.

APPENDIX A

Juvenile Data from the 2001 Fall Chinook Salmon Tagging Year

Appendix Table A1. Total hatchery fall Chinook salmon tagged at Lyons Ferry Hatchery and released above Lower Granite Dam in 2001.

	Released above Granite Dam tailrace				
Tag Date	Tagged	Mortalities	Lost tags	Duplicates	Released
18-May-01	5,305	1	8	3	5,293
19-May-01	8,395		7	3	8,385
20-May-01	8,643	2	15	6	8,620
21-May-01	10,606	2	14	13	10,577
22-May-01	11,652	3	11	9	11,629
24-May-01	11,370	1	26	6	11,337
25-May-01	11,575	4	31	2	11,538
26-May-01	6,867	0	1	0	6,866

Appendix Table A2. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Lower Granite Dam juvenile fish facility, 2001 study year.

	Detected once at Lower Granite Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
22-May-01	-	-	-	-	2	-	-
23-May-01	-	-	-	-	2	-	-
24-May-01	-	-	-	-	2	-	-
25-May-01	-	-	-	-	6	-	-
26-May-01	1	-	-	-	2	-	-
27-May-01	-	-	-	-	17	-	-
28-May-01	-	-	-	-	15	-	1
29-May-01	-	-	-	-	7	1	-
30-May-01	-	-	-	-	4	-	-
31-May-01	-	-	-	-	10	-	-
1-Jun-01	-	-	-	-	9	1	-
2-Jun-01	-	-	-	-	8	-	-
3-Jun-01	-	-	-	-	16	-	-
4-Jun-01	-	-	-	-	56	7	2
5-Jun-01	-	-	-	-	87	9	-
6-Jun-01	1	-	-	2	293	27	1
7-Jun-01	-	-	-	1	414	12	-
8-Jun-01	3	-	-	2	510	11	1
9-Jun-01	-	-	-	2	463	13	-
10-Jun-01	1	-	-	-	340	5	-
11-Jun-01	-	-	-	-	534	8	-
12-Jun-01	-	1	-	-	537	42	315
13-Jun-01	2	1	-	4	11	43	856
14-Jun-01	-	-	-	1	7	16	407
15-Jun-01	-	-	-	-	-	3	181
16-Jun-01	-	-	-	-	1	4	101
17-Jun-01	1	-	-	-	-	7	127
18-Jun-01	-	-	-	4	5	14	373
19-Jun-01	-	-	-	-	10	25	362
20-Jun-01	2	1	-	-	5	16	354
21-Jun-01	-	-	-	2	-	15	177
22-Jun-01	2	-	-	-	2	4	222
23-Jun-01	-	-	-	-	8	21	416
24-Jun-01	-	-	-	1	1	16	281
25-Jun-01	1	-	-	-	3	9	301
26-Jun-01	-	-	-	-	1	20	372
27-Jun-01	1	-	-	1	-	9	221
28-Jun-01	-	-	-	-	1	16	230
29-Jun-01	-	-	-	-	1	6	158
30-Jun-01	-	-	-	-	-	3	119
1-Jul-01	-	-	-	-	-	9	145
2-Jul-01	-	-	-	1	-	13	232
3-Jul-01	3	2	1	3	60	70	1,693
4-Jul-01	10	1	-	5	83	39	2,004

Appendix Table A2. Continued.

	Detected once at Lower Granite Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
5-Jul-01	3	-	-	1	11	8	714
6-Jul-01	-	1	-	1	15	30	681
7-Jul-01	-	1	-	-	17	40	861
8-Jul-01	-	-	-	2	11	28	643
9-Jul-01	1	-	-	1	2	12	245
10-Jul-01	-	-	1	-	4	11	282
11-Jul-01	1	-	-	1	3	11	285
12-Jul-01	-	-	-	-	3	13	336
13-Jul-01	-	-	-	-	-	8	272
14-Jul-01	-	-	-	-	1	11	254
15-Jul-01	-	-	-	-	-	7	213
16-Jul-01	1	-	-	-	-	7	139
17-Jul-01	1	-	-	-	3	4	192
18-Jul-01	-	-	-	-	2	13	230
19-Jul-01	-	-	-	1	1	6	157
20-Jul-01	-	-	-	-	4	8	98
21-Jul-01	-	-	-	-	-	5	76
22-Jul-01	-	-	-	-	-	4	50
23-Jul-01	-	-	-	-	-	3	51
24-Jul-01	-	-	-	-	-	7	58
25-Jul-01	1	-	-	-	-	13	38
26-Jul-01	-	-	-	-	-	12	49
27-Jul-01	-	-	-	-	1	14	34
28-Jul-01	-	-	-	-	-	10	39
29-Jul-01	-	-	-	-	-	14	27
30-Jul-01	-	-	-	-	-	8	35
31-Jul-01	-	-	-	-	-	13	41
1-Aug-01	-	-	-	-	-	14	46
2-Aug-01	-	-	-	-	1	16	27
3-Aug-01	-	-	-	-	-	7	31
4-Aug-01	-	-	-	-	-	11	30
5-Aug-01	-	-	-	-	1	10	25
6-Aug-01	-	-	-	-	-	10	35
7-Aug-01	-	-	-	-	-	9	28
8-Aug-01	-	-	-	-	1	3	22
9-Aug-01	1	-	-	-	1	16	44
10-Aug-01	-	-	-	-	-	35	77
11-Aug-01	-	-	-	1	2	30	128
12-Aug-01	1	-	-	1	2	20	160
13-Aug-01	2	-	-	2	1	23	236
14-Aug-01	-	-	-	-	1	13	185
15-Aug-01	-	-	-	-	-	5	137
16-Aug-01	1	-	-	-	1	8	67
17-Aug-01	-	-	-	-	2	3	57
18-Aug-01	-	-	-	-	-	3	52
19-Aug-01	-	-	-	-	-	5	25
20-Aug-01	-	-	-	1	-	5	24

Appendix Table A2. Continued.

	Detected once at Lower Granite Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
21-Aug-01	-	-	-	-	-	3	17
22-Aug-01	-	-	-	-	-	8	19
23-Aug-01	-	-	-	-	-	7	18
24-Aug-01	-	-	-	-	1	4	22
25-Aug-01	-	-	-	-	-	1	10
26-Aug-01	-	-	-	-	-	2	6
27-Aug-01	-	-	-	-	-	2	12
28-Aug-01	-	-	-	-	-	4	14
29-Aug-01	-	-	-	-	-	3	12
30-Aug-01	1	-	-	-	-	-	11
31-Aug-01	1	-	-	-	-	3	20
1-Sep-01	-	-	-	1	-	5	13
2-Sep-01	-	-	-	-	-	1	5
3-Sep-01	-	-	-	-	-	2	11
4-Sep-01	-	-	-	-	-	2	3
5-Sep-01	-	-	-	-	1	6	2
6-Sep-01	-	-	-	-	-	7	-
7-Sep-01	-	-	-	-	-	3	-
8-Sep-01	-	-	-	-	-	2	-
9-Sep-01	-	-	-	-	-	2	-
10-Sep-01	-	-	-	-	-	8	-
11-Sep-01	-	-	-	-	-	4	-
12-Sep-01	-	-	-	-	-	8	-
13-Sep-01	-	-	-	-	-	8	-
14-Sep-01	-	-	-	-	-	3	-
15-Sep-01	-	-	-	-	-	5	-
16-Sep-01	-	-	-	-	-	8	-
17-Sep-01	-	-	-	-	-	5	-
18-Sep-01	-	-	-	-	-	3	-
19-Sep-01	-	-	-	-	-	3	-
21-Sep-01	-	-	-	-	-	7	-
22-Sep-01	-	-	-	-	-	12	-
23-Sep-01	-	-	-	-	-	25	-
24-Sep-01	-	-	-	-	-	18	-
25-Sep-01	-	-	-	-	-	14	-
26-Sep-01	-	-	-	-	-	13	-
27-Sep-01	-	-	1	-	-	13	-
28-Sep-01	-	-	-	-	-	10	-
29-Sep-01	-	-	-	-	-	3	-
30-Sep-01	-	-	-	-	-	6	-
1-Oct-01	-	-	-	-	-	4	-
2-Oct-01	-	-	-	-	-	2	-
3-Oct-01	-	-	-	-	-	4	-
4-Oct-01	-	-	-	-	-	1	-
5-Oct-01	-	-	-	-	-	1	-
6-Oct-01	-	-	-	-	-	2	-

Appendix Table A2. Continued.

	Detected once at Lower Granite Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
11-Oct-01	-	-	-	-	-	1	-
13-Oct-01	-	-	-	-	-	2	-
14-Oct-01	-	-	-	-	-	1	-
16-Oct-01	-	-	-	-	-	2	-
18-Oct-01	-	-	-	-	-	1	-
19-Oct-01	-	-	-	-	-	2	-
20-Oct-01	-	-	-	-	-	2	-
21-Oct-01	-	-	-	-	-	5	-
22-Oct-01	-	-	-	-	-	3	-
23-Oct-01	-	-	-	-	-	3	-
24-Oct-01	-	-	-	-	-	8	-
25-Oct-01	-	-	-	-	-	3	-
26-Oct-01	-	-	-	-	-	2	-
27-Oct-01	-	-	-	-	-	1	-
28-Oct-01	-	-	-	-	-	9	-
29-Oct-01	-	-	-	-	1	34	-
30-Oct-01	-	-	-	-	-	19	5
31-Oct-01	-	-	-	-	-	2	11
20-Mar-02	-	1	-	-	-	-	-
26-Mar-02	-	-	-	-	2	1	-
27-Mar-02	-	-	-	-	1	1	-
28-Mar-02	-	-	-	-	1	-	-
29-Mar-02	-	-	-	-	6	-	-
30-Mar-02	-	-	-	-	1	-	-
2-Apr-02	-	-	-	-	3	-	-
3-Apr-02	-	-	-	-	1	-	-
4-Apr-02	-	-	-	-	1	-	-
5-Apr-02	-	-	-	-	2	-	-
6-Apr-02	-	-	-	-	1	-	-
7-Apr-02	-	-	-	-	2	1	-
8-Apr-02	-	-	-	-	-	1	-
9-Apr-02	-	-	-	-	3	-	-
10-Apr-02	-	-	-	-	1	-	-
12-Apr-02	-	-	-	-	1	-	-
13-Apr-02	-	-	-	-	3	-	-
14-Apr-02	-	-	-	-	2	-	-
15-Apr-02	-	-	-	-	3	-	-
18-Apr-02	-	-	-	-	1	-	-
20-Apr-02	-	-	-	-	1	-	-
23-Apr-02	-	-	-	-	2	-	-
25-Apr-02	-	-	-	-	2	-	-
28-Apr-02	-	-	-	-	3	-	-
29-Apr-02	-	-	-	-	1	-	-
30-Apr-02	-	-	-	-	1	-	-
1-May-02	-	-	-	-	1	-	-
6-May-02	-	-	-	-	1	-	-
15-May-02	-	-	-	-	-	1	-

Appendix Table A3. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Little Goose Dam juvenile fish facility, 2001 study year.

	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
28-May-01	-	-	-	-	2	-	-
29-May-01	-	-	-	-	1	-	-
31-May-01	-	-	-	-	1	1	-
1-Jun-01	-	-	-	-	1	-	-
2-Jun-01	-	-	-	-	1	-	-
7-Jun-01	-	-	-	-	1	-	-
9-Jun-01	-	-	-	-	-	2	-
10-Jun-01	-	-	-	-	-	-	1
11-Jun-01	-	-	-	-	2	-	-
12-Jun-01	-	-	-	-	-	-	3
13-Jun-01	-	-	-	-	-	3	16
14-Jun-01	-	-	-	-	-	8	26
15-Jun-01	-	-	-	-	-	9	62
16-Jun-01	3	-	-	-	-	7	99
17-Jun-01	-	-	-	-	-	6	47
18-Jun-01	1	-	-	-	-	4	25
19-Jun-01	-	-	-	-	-	4	16
20-Jun-01	-	-	-	-	-	1	13
21-Jun-01	1	-	-	-	-	4	20
22-Jun-01	2	-	2	-	1	14	48
23-Jun-01	-	-	-	-	-	10	105
24-Jun-01	2	-	-	-	-	11	59
25-Jun-01	1	1	-	-	3	21	116
26-Jun-01	-	-	-	-	-	18	105
27-Jun-01	-	-	-	-	1	2	36
28-Jun-01	-	-	-	-	-	5	26
29-Jun-01	-	-	-	-	-	15	77
30-Jun-01	-	-	-	-	-	16	61
1-Jul-01	-	-	-	-	-	7	72
2-Jul-01	-	-	-	-	-	6	23
3-Jul-01	2	-	-	-	1	36	159
4-Jul-01	2	-	-	-	-	26	278
5-Jul-01	-	-	-	-	8	5	449
6-Jul-01	2	-	-	-	4	11	523
7-Jul-01	1	-	-	-	8	9	283
8-Jul-01	1	-	-	-	1	5	170
9-Jul-01	2	2	-	-	17	8	206
10-Jul-01	2	-	-	-	4	19	373
11-Jul-01	-	-	-	-	3	2	251

Appendix Table A3. Continued.

Detection date	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
12-Jul-01	2	-	-	-	1	10	316
13-Jul-01	2	-	-	-	5	13	400
14-Jul-01	5	-	-	1	-	4	176
15-Jul-01	-	-	-	-	-	3	76
16-Jul-01	-	-	-	-	-	8	116
17-Jul-01	1	-	-	-	-	7	83
18-Jul-01	-	-	-	-	-	4	34
19-Jul-01	-	-	1	-	-	13	35
20-Jul-01	-	-	-	-	1	9	38
21-Jul-01	2	-	-	-	-	10	30
22-Jul-01	-	-	1	-	-	16	43
23-Jul-01	-	-	-	-	-	8	32
24-Jul-01	-	-	-	-	-	6	27
25-Jul-01	-	-	-	-	-	7	37
26-Jul-01	-	-	-	-	-	8	32
27-Jul-01	-	-	-	-	-	8	15
28-Jul-01	-	-	-	-	-	5	14
29-Jul-01	2	-	-	-	-	12	37
30-Jul-01	1	-	-	-	1	7	36
31-Jul-01	-	-	-	-	-	8	26
1-Aug-01	-	-	-	-	-	3	15
2-Aug-01	-	-	-	-	-	12	22
3-Aug-01	1	-	-	-	1	14	26
4-Aug-01	1	-	-	-	-	12	28
5-Aug-01	1	-	-	-	-	6	27
6-Aug-01	-	-	-	-	-	11	20
7-Aug-01	-	-	-	-	-	7	19
8-Aug-01	1	-	-	-	-	4	9
9-Aug-01	1	-	-	-	-	7	13
10-Aug-01	-	-	-	-	-	8	11
11-Aug-01	-	-	-	-	-	8	18
12-Aug-01	1	-	-	-	-	6	32
13-Aug-01	-	-	-	-	1	10	27
14-Aug-01	-	-	-	-	-	12	17
15-Aug-01	4	-	1	-	-	15	33
16-Aug-01	-	-	-	-	-	16	16
17-Aug-01	-	-	1	-	-	17	2
18-Aug-01	-	-	-	-	-	11	10
19-Aug-01	-	-	-	-	-	10	7
20-Aug-01	-	-	-	-	1	9	5
21-Aug-01	-	-	-	-	-	9	8
22-Aug-01	-	-	-	-	-	5	7

Appendix Table A3. Continued.

	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
23-Aug-01	-	-	-	-	-	5	3
24-Aug-01	-	-	-	-	-	4	1
25-Aug-01	1	-	-	-	-	6	-
26-Aug-01	2	-	-	-	-	4	-
27-Aug-01	-	-	-	-	-	6	-
28-Aug-01	-	-	-	-	-	8	-
29-Aug-01	-	-	-	-	-	6	-
30-Aug-01	-	-	-	-	-	9	-
31-Aug-01	-	-	-	-	-	1	-
1-Sep-01	-	-	-	-	-	2	-
2-Sep-01	-	-	-	-	-	3	-
3-Sep-01	-	-	-	-	-	2	-
4-Sep-01	-	-	-	-	-	6	-
5-Sep-01	1	-	-	-	-	9	-
6-Sep-01	-	-	-	-	-	1	-
7-Sep-01	-	-	1	-	-	1	-
8-Sep-01	-	-	-	-	-	2	-
9-Sep-01	-	-	-	-	-	2	-
10-Sep-01	-	-	-	-	-	1	-
11-Sep-01	-	-	-	-	-	2	-
12-Sep-01	-	-	-	-	-	1	-
13-Sep-01	-	-	-	-	-	3	-
14-Sep-01	-	-	-	-	-	4	-
15-Sep-01	-	-	-	-	-	5	-
16-Sep-01	-	-	-	-	-	9	-
17-Sep-01	-	-	-	-	-	11	-
18-Sep-01	1	-	-	-	-	22	-
19-Sep-01	-	-	1	-	-	10	-
20-Sep-01	1	-	-	-	-	5	-
21-Sep-01	-	-	-	-	-	3	-
22-Sep-01	-	-	-	-	-	7	-
23-Sep-01	-	-	-	-	-	3	-
24-Sep-01	-	-	-	-	-	2	-
25-Sep-01	-	-	-	-	-	2	-
26-Sep-01	-	-	-	-	-	1	-
27-Sep-01	-	-	-	-	-	3	-
28-Sep-01	-	-	-	-	-	3	-
29-Sep-01	-	-	-	-	-	1	-
30-Sep-01	-	-	-	-	-	2	-
1-Oct-01	-	-	-	-	-	5	-

Appendix Table A3. Continued.

	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
2-Oct-01	-	-	-	-	-	3	-
4-Oct-01	-	-	-	-	-	1	-
6-Oct-01	-	-	-	-	-	1	-
7-Oct-01	-	-	-	-	-	2	-
9-Oct-01	-	-	-	-	-	2	-
10-Oct-01	-	-	-	-	-	1	-
11-Oct-01	-	-	-	-	-	1	-
12-Oct-01	-	-	-	-	-	1	-
13-Oct-01	-	-	-	-	-	4	-
14-Oct-01	-	-	-	-	-	4	-
15-Oct-01	-	-	-	-	-	4	-
16-Oct-01	2	-	-	-	-	4	-
17-Oct-01	1	-	-	-	-	4	-
18-Oct-01	-	-	-	-	-	3	-
19-Oct-01	-	-	-	-	-	4	-
21-Oct-01	-	-	-	-	-	3	-
22-Oct-01	-	-	-	-	-	2	-
23-Oct-01	-	-	-	-	-	1	-
24-Oct-01	-	-	-	-	-	3	-
25-Oct-01	-	-	-	-	-	2	-
26-Oct-01	-	-	-	-	-	1	-
27-Oct-01	-	-	-	-	-	2	-
29-Oct-01	-	-	-	-	-	3	-
30-Oct-01	-	-	-	-	-	3	-
31-Oct-01	-	-	-	-	2	9	-
2-Apr-02	-	-	-	-	4	1	-
3-Apr-02	-	-	-	-	4	1	-
4-Apr-02	-	-	-	-	4	-	-
6-Apr-02	-	-	-	-	1	-	-
8-Apr-02	-	-	-	-	1	-	-
10-Apr-02	-	-	-	-	1	-	-
13-Apr-02	-	-	-	-	2	-	-
14-Apr-02	-	-	-	-	4	-	-
15-Apr-02	-	-	-	-	3	-	-
16-Apr-02	-	-	-	-	1	-	-
17-Apr-02	-	-	-	-	2	-	-
18-Apr-02	-	-	-	-	6	-	-
19-Apr-02	-	-	-	-	9	-	-
20-Apr-02	-	-	-	-	4	1	-

Appendix Table A3. Continued.

	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
21-Apr-02	-	-	-	-	2	-	-
22-Apr-02	-	-	-	-	5	-	-
23-Apr-02	-	-	-	-	5	-	-
24-Apr-02	-	-	-	-	3	-	-
25-Apr-02	-	-	-	-	3	1	-
26-Apr-02	-	-	-	-	2	-	-
27-Apr-02	-	-	-	-	7	-	-
28-Apr-02	-	-	-	-	1	-	-
29-Apr-02	-	-	-	-	4	-	-
30-Apr-02	-	-	-	-	1	-	-
1-May-02	-	-	-	-	8	-	-
2-May-02	-	-	-	-	6	-	-
3-May-02	-	-	-	-	5	-	-
4-May-02	-	-	-	-	4	-	-
5-May-02	-	-	-	-	3	-	-
6-May-02	-	-	-	-	3	-	-
7-May-02	-	-	-	-	1	-	-
8-May-02	-	-	-	-	5	-	-
9-May-02	-	-	-	-	1	-	-
11-May-02	-	-	-	-	2	-	-
12-May-02	-	-	-	-	1	-	-
15-May-02	-	-	-	-	1	-	-
17-May-02	-	-	-	-	2	-	-
18-May-02	-	-	-	-	1	-	-
19-May-02	-	-	-	-	1	-	-

Appendix Table A4. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Lower Monumental Dam juvenile fish facility, 2001 study year.

	Detected once at Lower Monumental Dam (coil location)		Detected on separator and one additional coil (coil location)			
Detection date	Separator	Sample	Diversion	Sample	River	Raceway
15-Jun-01	-	-	-	-	-	2
16-Jun-01	-	-	-	-	-	1
17-Jun-01	-	-	-	-	-	1
18-Jun-01	-	-	-	-	-	1
19-Jun-01	-	-	-	-	-	1
20-Jun-01	-	-	-	1	-	1
22-Jun-01	-	-	-	-	-	1
23-Jun-01	-	-	-	1	-	-
25-Jun-01	-	-	-	-	-	6
26-Jun-01	-	-	-	1	-	3
27-Jun-01	-	-	-	-	-	3
28-Jun-01	-	-	-	-	-	1
29-Jun-01	-	-	-	-	-	1
30-Jun-01	-	-	-	-	-	4
1-Jul-01	-	-	-	-	-	3
2-Jul-01	-	-	-	1	-	1
3-Jul-01	-	-	-	-	-	1
4-Jul-01	-	-	-	1	-	3
5-Jul-01	-	-	-	-	-	5
6-Jul-01	-	-	-	-	-	6
7-Jul-01	-	-	-	2	-	6
8-Jul-01	-	-	-	4	-	13
9-Jul-01	-	-	-	6	-	13
10-Jul-01	-	-	-	1	-	15
11-Jul-01	-	-	-	4	-	23
12-Jul-01	1	-	2	22	-	52
13-Jul-01	-	-	-	5	-	43
14-Jul-01	-	-	-	2	-	28
15-Jul-01	-	-	-	3	-	19
16-Jul-01	-	-	-	2	-	28
17-Jul-01	-	-	-	3	-	32
18-Jul-01	-	-	-	3	-	14
20-Jul-01	-	-	-	1	-	8
21-Jul-01	-	-	-	5	-	19
22-Jul-01	-	-	1	2	-	24
23-Jul-01	-	-	-	2	-	7
24-Jul-01	-	-	-	-	-	11
25-Jul-01	-	-	-	2	-	8
26-Jul-01	-	-	-	5	-	20
27-Jul-01	-	-	-	6	-	15
28-Jul-01	-	-	-	1	-	6
29-Jul-01	-	-	-	2	-	10
30-Jul-01	-	-	-	1	-	8
31-Jul-01	-	-	-	1	-	13
1-Aug-01	-	-	-	1	-	8
2-Aug-01	-	-	-	5	-	20

Appendix Table A4. Continued.

Detection date	Detected once at Lower Monumental Dam (coil location)		Detected on separator and one additional coil (coil location)			
	Separator	Sample	Diversion	Sample	River	Raceway
3-Aug-01	-	-	1	2	-	7
4-Aug-01	-	-	2	5	-	8
5-Aug-01	-	-	-	3	-	8
6-Aug-01	-	-	-	4	-	13
7-Aug-01	-	-	-	1	-	9
8-Aug-01	-	-	-	2	-	5
9-Aug-01	-	-	-	3	-	3
10-Aug-01	-	-	1	2	-	5
11-Aug-01	-	-	-	2	-	6
12-Aug-01	-	-	-	1	-	6
13-Aug-01	-	-	-	1	-	4
14-Aug-01	-	-	-	4	-	5
15-Aug-01	-	-	-	2	1	2
16-Aug-01	-	-	-	3	2	-
17-Aug-01	-	-	-	1	-	-
18-Aug-01	-	-	-	5	-	-
19-Aug-01	-	-	-	8	-	-
20-Aug-01	-	-	-	5	-	-
21-Aug-01	-	-	-	2	-	-
22-Aug-01	-	-	-	5	-	-
23-Aug-01	-	-	-	8	-	-
24-Aug-01	-	-	-	4	-	-
25-Aug-01	-	-	-	4	-	-
26-Aug-01	-	-	-	4	-	-
27-Aug-01	-	-	-	3	-	-
28-Aug-01	-	-	-	6	-	-
29-Aug-01	-	-	1	2	-	-
30-Aug-01	-	-	-	2	-	-
31-Aug-01	-	-	-	1	-	-
1-Sep-01	-	-	-	2	-	-
2-Sep-01	-	-	-	1	-	-
3-Sep-01	-	-	-	1	-	-
4-Sep-01	-	-	-	3	-	-
5-Sep-01	1	-	-	5	-	-
6-Sep-01	3	-	-	2	-	-
8-Sep-01	-	-	-	1	-	-
9-Sep-01	-	-	-	2	-	-
10-Sep-01	-	-	-	1	-	-
11-Sep-01	-	-	-	3	-	-
12-Sep-01	-	-	-	1	-	-
13-Sep-01	-	-	-	1	-	-
14-Sep-01	-	-	-	2	-	-
16-Sep-01	-	-	-	1	-	-
17-Sep-01	-	-	-	3	-	-
20-Sep-01	-	-	-	1	-	-
25-Sep-01	-	1	-	-	-	-
26-Sep-01	-	-	-	1	-	-
1-Oct-01	-	-	-	2	-	-

Appendix Table A4. Continued.

Detection date	Detected once at Lower Monumental Dam (coil location)		Detected on separator and one additional coil (coil location)			
	Separator	Sample	Diversion	Sample	River	Raceway
3-Oct-01	-	-	-	2	-	-
4-Oct-01	-	-	-	2	-	-
12-Oct-01	-	-	-	2	-	-
13-Oct-01	-	-	-	1	-	-
16-Oct-01	-	-	-	1	-	-
17-Oct-01	-	-	-	1	-	-
18-Oct-01	-	-	-	1	-	-
23-Oct-01	-	-	-	1	-	-
25-Oct-01	-	-	-	1	-	-
28-Oct-01	-	-	-	3	-	-
29-Oct-01	-	-	-	1	-	-
2-Apr-02	-	-	6	-	-	-
3-Apr-02	-	-	4	1	-	-
4-Apr-02	-	-	1	-	-	-
5-Apr-02	-	-	1	-	-	-
6-Apr-02	-	-	1	-	-	-
7-Apr-02	-	-	2	-	-	-
30-Apr-02	-	-	13	2	-	-
1-May-02	-	-	19	-	-	-
2-May-02	-	-	7	-	-	-
3-May-02	-	-	8	-	-	-
4-May-02	-	-	31	-	-	-
5-May-02	-	-	17	-	-	-
6-May-02	-	-	3	-	-	-
7-May-02	-	-	20	-	-	-
8-May-02	-	-	4	-	-	-
9-May-02	-	-	5	-	-	-
10-May-02	-	-	10	-	-	-
11-May-02	-	-	-	-	-	6
12-May-02	-	-	4	-	-	-
13-May-02	-	-	4	-	-	-
14-May-02	-	-	3	-	-	-
15-May-02	-	-	3	-	-	-
16-May-02	-	-	6	-	-	-
17-May-02	-	-	4	-	-	-
18-May-02	-	-	1	-	-	-
19-May-02	-	-	4	-	-	-
20-May-02	-	-	2	-	-	-
21-May-02	-	-	3	-	-	-
22-May-02	-	-	4	-	-	-
23-May-02	-	-	1	-	-	-
24-May-02	-	-	3	-	-	-
25-May-02	-	-	3	-	-	-
26-May-02	-	-	1	-	-	-
28-May-02	-	-	1	-	-	-
29-May-02	-	-	1	-	-	-

Appendix Table A5. Locations of observations (detections) of PIT-tagged fall Chinook salmon within the McNary Dam juvenile fish facility, 2001 study year.

	Detected on separator and additional coil(s) (coil location)								
Detection date	Diversion	Sample	Raceway	Diversion Raceway	Detection date	Diversion	Sample	Raceway	Diversion Raceway
16-Jun-01	-	-	1	-	21-Aug-01	-	1	2	-
27-Jun-01	-	-	1	-	23-Aug-01	-	-	3	-
9-Jul-01	-	1	-	-	24-Aug-01	-	-	1	-
10-Jul-01	-	-	1	-	25-Aug-01	-	-	1	-
12-Jul-01	-	1	2	-	26-Aug-01	-	-	3	-
13-Jul-01	-	-	3	-	28-Aug-01	-	-	4	-
14-Jul-01	1	-	3	-	29-Aug-01	-	-	4	-
15-Jul-01	-	-	18	-	30-Aug-01	-	-	4	-
16-Jul-01	-	-	16	-	31-Aug-01	-	-	1	-
17-Jul-01	1	1	12	-	1-Sep-01	-	-	2	-
18-Jul-01	-	-	17	-	2-Sep-01	-	-	1	-
19-Jul-01	-	-	10	-	4-Sep-01	-	-	1	-
20-Jul-01	1	-	7	-	5-Sep-01	-	1	2	-
21-Jul-01	-	-	13	-	6-Sep-01	-	-	1	-
22-Jul-01	-	-	8	-	7-Sep-01	-	-	2	-
23-Jul-01	-	-	4	-	8-Sep-01	-	-	1	-
24-Jul-01	-	-	14	-	9-Sep-01	-	-	1	-
25-Jul-01	-	-	9	-	11-Sep-01	-	-	1	-
26-Jul-01	-	1	10	-	21-Sep-01	-	1	-	-
27-Jul-01	-	1	5	-	28-Sep-01	-	-	1	-
28-Jul-01	-	-	9	-	30-Sep-01	-	-	1	-
29-Jul-01	-	-	10	-	2-Oct-01	-	-	1	-
30-Jul-01	-	-	6	-	8-Oct-01	-	-	1	-
31-Jul-01	-	-	3	-	14-Oct-01	-	-	1	-
2-Aug-01	-	1	4	-	16-Oct-01	-	-	1	-
3-Aug-01	-	-	3	-	18-Oct-01	-	-	1	-
4-Aug-01	-	-	5	-	21-Oct-01	-	-	1	-
5-Aug-01	1	-	2	-	23-Oct-01	-	-	1	-
6-Aug-01	-	-	2	-	24-Oct-01	-	1	-	-
7-Aug-01	-	-	4	-	30-Oct-01	-	-	2	-
8-Aug-01	-	-	5	-	7-Nov-01	-	-	2	-
9-Aug-01	-	-	3	-	11-Nov-01	-	-	1	-
10-Aug-01	-	-	3	-	16-Nov-01	-	-	1	-
11-Aug-01	-	-	3	-	20-Nov-01	-	-	-	1
12-Aug-01	-	-	3	-	21-Nov-01	-	-	1	-
13-Aug-01	-	-	1	-	23-Nov-01	-	-	1	-
14-Aug-01	-	-	2	-	24-Nov-01	-	-	3	-
15-Aug-01	-	-	2	-	25-Nov-01	-	-	1	-
16-Aug-01	-	-	4	-	26-Nov-01	-	-	1	-
17-Aug-01	-	-	4	-	27-Nov-01	-	-	4	-
18-Aug-01	-	-	1	-	28-Nov-01	-	1	2	2
19-Aug-01	-	-	6	-	29-Nov-01	-	-	-	-
20-Aug-01	-	-	4	-	30-Nov-01	2	-	-	-

Appendix Table A5. Continued.

Detection date	Diversion	Sample	Raceway	Diversion Raceway	Detection date	Diversion	Sample	Raceway	Diversion Raceway
	Detected on separator and additional coil(s) (coil location)								
3-Dec-01	-	-	1	-	11-May-02	3	-	-	-
4-Dec-01	-	1	-	-	12-May-02	6	-	-	-
5-Dec-01	-	2	1	-	13-May-02	7	-	-	-
6-Dec-01	-	-	1	-	14-May-02	4	-	-	-
7-Dec-01	-	1	1	-	15-May-02	2	-	-	-
8-Dec-01	2	-	3	-	16-May-02	4	-	-	-
9-Dec-01	-	1	-	1	17-May-02	1	-	-	-
					18-May-02	2	-	-	-
2-Apr-02	1	-	-	-	19-May-02	4	-	-	-
3-Apr-02	2	-	-	2	20-May-02	2	-	-	-
4-Apr-02	1	-	-	-	21-May-02	3	-	-	-
5-Apr-02	1	-	-	-	22-May-02	2	-	-	-
6-Apr-02	-	-	-	-	24-May-02	2	-	-	-
7-Apr-02	1	-	-	-	25-May-02	1	-	-	-
9-Apr-02	1	-	-	-	29-May-02	2	-	-	-
11-Apr-02	1	-	-	-					
12-Apr-02	1	-	-	-					
13-Apr-02	1	-	-	-					
16-Apr-02	1	-	-	-					
18-Apr-02	5	-	-	-					
19-Apr-02	1	-	-	-					
20-Apr-02	2	-	-	-					
22-Apr-02	1	-	-	-					
23-Apr-02	2	-	-	-					
24-Apr-02	9	-	-	-					
25-Apr-02	8	-	-	-					
26-Apr-02	7	-	-	-					
27-Apr-02	5	-	-	-					
28-Apr-02	4	-	-	-					
29-Apr-02	6	-	-	-					
30-Apr-02	6	-	-	-					
1-May-02	3	-	-	-					
2-May-02	12	-	-	-					
3-May-02	14	-	-	-					
4-May-02	20	-	-	-					
5-May-02	8	-	-	-					
6-May-02	12	-	-	-					
7-May-02	12	-	-	-					
8-May-02	5	-	-	-					
9-May-02	8	-	-	-					
10-May-02	4	-	1	-					

APPENDIX B

Juvenile Data from the 2002 Fall Chinook Salmon Tagging Year

Appendix Table B1. Total hatchery fall Chinook salmon tagged at Lyons Ferry Hatchery and released above Lower Granite Dam in 2002. "Unknown loss" is probably due to mortality or tag loss; however, the reason was not recorded.

	Released above Lower Granite Dam tailrace				
Tag Date	Tagged	Mortalities	Lost tags	Unknown loss	Released
29-May-02	4,785	13	-	49	4,723
30-May-02	5,933	-	-	48	5,885
31-May-02	5,510	-	-	46	5,464
03-Jun-02	6,733	-	-	35	6,698
04-Jun-02	5,168	-	-	27	5,141
05-Jun-02	7,251	-	1	49	7,201
06-Jun-02	10,115	-	-	53	10,062
07-Jun-02	8,933	-	-	-	8,933
10-Jun-02	9,041	4	12	2	9,023
11-Jun-02	7,246	1	5	1	7,239
12-Jun-02	8,731	7	14	4	8,706
13-Jun-02	12,727	7	15	2	12,703
14-Jun-02	6,159	6	13	2	6,138

Appendix Table B2. Total fall Chinook salmon tagged at Lower Granite Dam during fall 2002.

	Tagged at, and transported from, Lower Granite Dam				
Tag Date	Tagged	Mortalities	Lost tags	Duplicates	Released
05-Sep-02	103	-	-	-	103
06-Sep-02	101	-	-	-	101
11-Sep-02	155	-	-	-	155
13-Sep-02	131	-	-	-	131
17-Sep-02	101	-	-	-	101
18-Sep-02	81	-	-	-	81
19-Sep-02	101	-	-	-	101
21-Sep-02	82	-	-	-	82
25-Sep-02	145	-	-	-	145
27-Sep-02	177	-	-	-	177
01-Oct-02	84	-	-	-	84
03-Oct-02	162	-	-	-	162
05-Oct-02	86	-	-	-	86
09-Oct-02	162	-	-	-	162
11-Oct-02	167	-	-	-	167
15-Oct-02	57	-	-	-	57
17-Oct-02	114	-	-	-	114
23-Oct-02	164	-	-	-	164
25-Oct-02	162	-	-	-	162
29-Oct-02	171	-	-	-	171

Appendix Table B3. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Lower Granite Dam juvenile fish facility, 2002 study year.

	Detected once at Lower Granite Dam (coil location)				Detected on separator and additional coil(s) (coil location)			
Detection date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway	Sample Raceway
31-May-02	-	-	-	-	1	-	-	-
1-Jun-02	-	-	-	-	-	-	3	-
2-Jun-02	-	-	-	-	1	-	1	-
3-Jun-02	-	-	-	-	1	-	2	-
4-Jun-02	-	-	-	-	-	-	4	-
5-Jun-02	-	-	-	-	1	-	2	-
6-Jun-02	-	-	-	1	-	2	-	-
7-Jun-02	-	-	-	-	-	-	3	-
8-Jun-02	-	-	-	-	1	-	1	-
9-Jun-02	-	-	-	1	-	-	4	-
10-Jun-02	-	-	-	-	-	-	1	-
11-Jun-02	-	-	-	-	2	2	4	-
12-Jun-02	-	-	-	-	2	1	8	-
13-Jun-02	-	-	-	-	1	-	6	-
14-Jun-02	-	-	-	-	3	2	10	-
15-Jun-02	1	-	-	-	3	-	12	-
16-Jun-02	-	-	-	-	2	3	7	-
17-Jun-02	-	-	-	-	1	3	9	-
18-Jun-02	-	-	-	-	1	-	29	-
19-Jun-02	-	-	-	-	1	-	5	-
20-Jun-02	-	-	-	-	2	-	12	-
21-Jun-02	-	-	-	-	3	-	13	-
22-Jun-02	-	-	-	-	6	3	22	-
23-Jun-02	-	-	-	-	6	2	28	-
24-Jun-02	-	-	-	-	9	6	41	-
25-Jun-02	-	-	-	-	18	-	69	-
26-Jun-02	-	-	-	-	14	2	65	-
27-Jun-02	1	-	-	-	13	-	45	-
28-Jun-02	-	-	-	-	6	-	27	-
29-Jun-02	1	-	-	1	43	8	139	-
30-Jun-02	1	-	-	1	127	15	460	-
1-Jul-02	1	-	-	-	44	1	177	-
2-Jul-02	-	-	-	-	11	1	43	-
3-Jul-02	-	-	-	-	15	9	55	-
4-Jul-02	-	-	-	2	25	11	93	-
5-Jul-02	2	-	-	1	151	72	565	-
6-Jul-02	3	-	-	2	194	58	718	-
7-Jul-02	-	-	-	2	60	5	238	-
8-Jul-02	-	-	-	2	85	11	309	-
9-Jul-02	1	-	-	1	68	6	251	-
10-Jul-02	-	-	-	-	32	6	105	-
11-Jul-02	-	-	-	-	16	3	68	-
12-Jul-02	-	-	-	-	12	5	47	-

Appendix Table B3. Continued.

Detection date	Detected once at Lower Granite Dam (coil location)				Detected on separator and additional coil(s) (coil location)			
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway	Sample Raceway
13-Jul-02	1	-	-	-	10	4	33	-
14-Jul-02	-	-	-	-	27	13	108	-
15-Jul-02	-	-	-	-	22	13	81	-
16-Jul-02	1	-	-	2	248	96	904	-
17-Jul-02	2	-	-	-	162	45	595	-
18-Jul-02	-	-	-	2	75	18	275	-
19-Jul-02	-	-	-	1	47	11	203	-
20-Jul-02	11	3	1	5	408	72	1,331	-
21-Jul-02	-	-	-	1	153	12	556	1
22-Jul-02	1	-	-	1	102	7	376	1
23-Jul-02	-	-	-	-	101	9	380	-
24-Jul-02	-	-	-	-	92	25	370	-
25-Jul-02	-	-	-	2	74	20	296	-
26-Jul-02	-	-	-	2	83	25	331	-
27-Jul-02	-	-	-	-	35	11	135	-
28-Jul-02	-	-	-	-	8	3	58	-
29-Jul-02	-	-	-	1	11	9	62	-
30-Jul-02	-	-	-	-	16	9	56	-
31-Jul-02	-	-	-	-	12	16	49	-
1-Aug-02	-	-	-	1	15	16	54	-
2-Aug-02	-	-	-	-	11	14	52	-
3-Aug-02	-	-	-	1	13	13	40	-
4-Aug-02	-	-	-	-	7	14	27	-
5-Aug-02	-	-	-	-	7	10	30	-
6-Aug-02	-	-	1	-	7	14	30	-
7-Aug-02	-	-	-	-	8	10	36	-
8-Aug-02	-	-	-	-	5	3	17	-
9-Aug-02	-	-	-	-	2	11	13	-
10-Aug-02	-	-	-	-	8	7	26	-
11-Aug-02	-	-	-	-	5	7	21	-
12-Aug-02	-	-	-	-	5	4	17	-
13-Aug-02	-	-	-	-	4	4	13	-
14-Aug-02	-	-	-	-	3	6	12	-
15-Aug-02	-	-	-	1	7	4	16	-
16-Aug-02	-	-	-	-	6	7	21	-
17-Aug-02	-	-	-	-	5	4	14	-
18-Aug-02	-	-	-	-	4	5	16	-
19-Aug-02	-	-	-	-	2	7	5	-
20-Aug-02	-	-	-	-	4	4	13	-
21-Aug-02	-	-	-	-	6	15	21	-
22-Aug-02	-	-	-	-	8	9	33	-
23-Aug-02	-	-	-	-	4	5	21	-
24-Aug-02	-	-	-	-	8	9	24	-
25-Aug-02	-	-	-	1	6	16	40	-
26-Aug-02	-	-	-	1	10	10	27	-
27-Aug-02	1	-	-	-	6	18	28	-

Appendix Table B3. Continued.

Detection date	Detected once at Lower Granite Dam (coil location)				Detected on separator and additional coil(s) (coil location)			
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway	Sample Raceway
28-Aug-02	-	-	-	-	10	10	26	-
29-Aug-02	-	-	-	-	6	8	20	-
30-Aug-02	-	-	-	-	10	22	27	-
31-Aug-02	-	-	-	-	7	11	25	-
1-Sep-02	-	-	-	-	4	5	16	-
2-Sep-02	-	-	-	-	4	8	9	-
3-Sep-02	-	-	-	-	4	5	9	-
4-Sep-02	-	-	-	-	7	5	14	-
5-Sep-02	-	-	-	-	3	5	17	-
6-Sep-02	-	-	-	-	4	11	13	-
7-Sep-02	-	-	-	-	2	5	12	-
8-Sep-02	-	-	-	-	2	2	7	-
9-Sep-02	-	-	-	-	3	5	7	-
10-Sep-02	-	-	-	-	2	4	12	-
11-Sep-02	-	-	-	-	2	5	6	-
12-Sep-02	-	-	-	-	1	5	9	-
13-Sep-02	-	-	-	-	-	4	3	-
14-Sep-02	-	-	-	-	-	1	2	-
15-Sep-02	-	-	-	-	2	3	7	-
16-Sep-02	-	-	-	-	3	2	12	-
17-Sep-02	-	-	-	1	1	7	9	-
18-Sep-02	-	-	-	-	3	4	16	-
19-Sep-02	-	-	-	-	3	4	7	-
20-Sep-02	-	-	-	-	5	3	15	-
21-Sep-02	-	-	-	-	1	2	6	-
22-Sep-02	-	-	-	-	3	3	9	-
23-Sep-02	-	-	-	-	1	2	6	-
24-Sep-02	-	-	-	-	1	-	4	-
25-Sep-02	-	-	-	-	2	4	11	-
26-Sep-02	-	-	-	-	3	4	4	-
27-Sep-02	-	-	-	-	2	5	5	-
28-Sep-02	-	-	-	-	2	3	6	-
29-Sep-02	-	-	-	-	4	2	15	-
30-Sep-02	1	-	-	-	1	8	9	-
1-Oct-02	-	-	-	-	5	5	14	-
2-Oct-02	-	-	-	-	1	6	5	-
3-Oct-02	-	-	-	-	3	2	14	-
4-Oct-02	-	-	-	-	3	5	11	-
5-Oct-02	-	-	-	-	5	4	13	-
6-Oct-02	-	-	-	-	2	5	13	-
7-Oct-02	-	-	1	-	4	7	11	-
8-Oct-02	-	-	-	-	1	3	2	-
9-Oct-02	-	-	-	-	3	5	8	-
10-Oct-02	-	-	-	-	-	1	3	-
11-Oct-02	-	-	-	-	4	2	11	-

Appendix Table B3. Continued.

Detection date	Detected once at Lower Granite Dam (coil location)				Detected on separator and additional coil(s) (coil location)			
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway	Sample Raceway
12-Oct-02	-	-	1	-	2	1	13	-
13-Oct-02	-	-	-	-	3	-	6	-
14-Oct-02	-	-	-	-	-	-	4	-
15-Oct-02	-	-	-	-	2	5	2	-
16-Oct-02	-	-	-	-	-	-	1	-
17-Oct-02	-	-	-	-	-	3	2	-
18-Oct-02	-	-	-	-	-	2	-	-
19-Oct-02	-	-	-	-	1	4	-	-
20-Oct-02	-	-	-	-	-	3	-	-
21-Oct-02	-	-	-	-	-	1	-	-
22-Oct-02	-	-	-	-	-	2	-	-
23-Oct-02	-	-	-	-	-	1	-	-
24-Oct-02	-	-	-	-	1	2	-	-
25-Oct-02	-	-	-	-	1	9	-	-
26-Oct-02	-	-	-	-	1	9	-	-
27-Oct-02	-	-	-	-	-	3	-	-
28-Oct-02	-	-	-	-	-	8	-	-
29-Oct-02	-	-	-	-	2	9	-	-
30-Oct-02	-	-	-	-	2	27	-	-
31-Oct-02	-	-	-	-	-	1	2	-
25-Mar-03	-	-	-	1	1	2	-	-
26-Mar-03	-	-	-	1	5	-	1	-
27-Mar-03	-	-	-	-	10	-	-	-
28-Mar-03	-	-	-	-	5	3	-	-
30-Mar-03	-	-	-	-	1	-	-	-
31-Mar-03	-	-	-	-	2	-	-	-
1-Apr-03	-	-	-	-	10	-	-	-
2-Apr-03	-	-	-	-	21	-	-	-
3-Apr-03	-	-	-	-	21	-	-	-
4-Apr-03	-	-	-	-	4	-	-	-
5-Apr-03	-	-	-	-	9	-	-	-
8-Apr-03	-	-	-	-	1	-	-	-
9-Apr-03	-	-	-	-	2	-	-	-
11-Apr-03	-	-	-	-	2	-	-	-
12-Apr-03	-	-	-	-	5	-	-	-
13-Apr-03	-	-	-	-	5	-	-	-
14-Apr-03	-	-	-	-	1	-	-	-
15-Apr-03	-	-	-	1	2	-	-	-
16-Apr-03	-	-	-	-	2	-	-	-
17-Apr-03	-	-	-	-	1	-	-	-
19-Apr-03	-	-	-	-	1	-	-	-
21-Apr-03	-	-	-	-	1	-	-	-
22-Apr-03	-	-	-	-	4	-	-	-
23-Apr-03	-	-	-	-	6	-	2	-
24-Apr-03	-	-	-	-	2	-	-	-
28-Apr-03	-	-	-	-	1	-	-	-

Appendix Table B3. Continued.

Detection date	Detected once at Lower Granite Dam (coil location)				Detected on separator and additional coil(s) (coil location)			
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway	Sample Raceway
30-Apr-03	-	-	-	-	1	-	-	-
2-May-03	-	-	-	-	2	-	-	-
4-May-03	-	-	-	-	1	-	-	-
5-May-03	-	-	-	-	2	-	-	-
6-May-03	-	-	-	-	1	-	-	-
8-May-03	-	-	-	-	1	-	-	-
10-May-03	-	-	-	-	1	-	-	-
12-May-03	-	-	-	-	1	-	-	-
13-May-03	-	-	-	-	1	-	-	-

Appendix Table B4. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Little Goose Dam juvenile fish facility, 2002 study year.

Detection	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
date	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
4-Jun-02	-	-	-	-	1	-	-
8-Jun-02	-	-	-	-	-	-	1
11-Jun-02	-	-	-	-	-	-	1
12-Jun-02	-	-	-	-	-	-	1
14-Jun-02	-	-	-	-	-	-	1
15-Jun-02	-	-	-	-	2	-	-
16-Jun-02	-	-	-	-	-	1	2
17-Jun-02	-	-	-	-	1	-	2
18-Jun-02	-	-	-	-	2	-	2
19-Jun-02	-	-	-	-	-	-	3
20-Jun-02	-	1	-	-	2	1	4
21-Jun-02	-	-	-	-	1	-	6
22-Jun-02	-	-	-	-	1	-	5
23-Jun-02	-	-	-	-	-	-	2
24-Jun-02	-	-	-	-	1	-	2
25-Jun-02	-	-	-	-	1	2	4
26-Jun-02	-	-	-	-	1	2	6
27-Jun-02	-	-	-	-	2	-	8
28-Jun-02	-	-	-	-	2	-	6
29-Jun-02	-	-	-	-	9	8	36
30-Jun-02	1	-	-	-	17	7	71
1-Jul-02	-	-	-	-	8	1	21
2-Jul-02	-	-	-	-	8	2	33
3-Jul-02	-	-	-	-	3	3	15
4-Jul-02	-	-	-	-	5	3	15
5-Jul-02	1	-	-	-	20	11	73
6-Jul-02	-	-	-	-	20	11	80
7-Jul-02	-	-	-	-	10	1	34
8-Jul-02	-	-	-	-	8	2	28
9-Jul-02	-	-	-	-	6	3	24
10-Jul-02	-	-	-	-	7	7	18
11-Jul-02	-	-	-	-	6	10	23
12-Jul-02	-	-	-	-	5	5	13
13-Jul-02	2	-	-	-	24	26	64
14-Jul-02	2	-	1	2	79	44	247
15-Jul-02	-	-	-	-	24	13	69
16-Jul-02	1	-	-	-	40	19	137
17-Jul-02	-	-	-	-	39	11	139

Appendix Table B4. Continued.

Detection date	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
18-Jul-02	2	-	-	1	57	29	185
19-Jul-02	-	-	-	-	81	19	277
20-Jul-02	2	-	-	-	72	13	259
21-Jul-02	-	-	-	-	32	3	128
22-Jul-02	2	-	-	-	80	25	263
23-Jul-02	1	-	-	-	59	17	194
24-Jul-02	3	-	-	-	37	13	126
25-Jul-02	-	-	-	-	20	7	75
26-Jul-02	1	-	-	-	27	22	76
27-Jul-02	-	-	-	-	41	27	124
28-Jul-02	3	-	-	-	33	23	105
29-Jul-02	1	-	-	-	14	10	46
30-Jul-02	-	-	-	-	11	8	30
31-Jul-02	-	-	-	-	12	14	31
1-Aug-02	-	-	-	-	8	11	22
2-Aug-02	-	-	-	-	6	14	15
3-Aug-02	-	-	-	-	10	21	16
4-Aug-02	-	-	-	-	7	13	14
5-Aug-02	-	-	-	-	4	10	9
6-Aug-02	-	-	-	-	5	8	11
7-Aug-02	-	-	-	-	4	5	7
8-Aug-02	-	-	-	-	3	4	10
9-Aug-02	-	-	-	-	1	1	3
10-Aug-02	-	-	-	-	1	3	3
11-Aug-02	-	-	-	-	1	1	3
12-Aug-02	-	-	-	-	1	4	-
13-Aug-02	-	-	-	-	1	3	-
14-Aug-02	-	-	-	-	1	3	-
15-Aug-02	-	-	-	-	2	9	-
16-Aug-02	-	-	-	-	3	9	-
17-Aug-02	1	-	-	-	3	11	-
18-Aug-02	4	-	-	-	2	7	-
19-Aug-02	2	-	-	-	3	-	-
20-Aug-02	-	-	-	-	2	-	-
22-Aug-02	-	-	-	-	3	3	-
23-Aug-02	-	-	4	-	2	6	-
24-Aug-02	-	-	-	-	3	7	-
25-Aug-02	-	-	-	-	2	8	-
26-Aug-02	-	-	-	-	2	5	-
27-Aug-02	-	-	-	-	-	3	-

Appendix Table B4. Continued.

Detection date	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
28-Aug-02	-	-	-	-	3	6	-
29-Aug-02	-	-	-	-	-	3	-
30-Aug-02	-	-	-	-	2	10	-
31-Aug-02	-	-	-	-	4	10	-
1-Sep-02	-	-	-	-	1	6	-
2-Sep-02	-	-	-	-	2	6	-
3-Sep-02	-	-	-	-	2	6	-
4-Sep-02	-	-	-	-	1	7	-
5-Sep-02	-	-	-	-	1	2	-
6-Sep-02	-	-	-	-	1	3	-
7-Sep-02	-	-	-	-	-	3	-
8-Sep-02	-	-	-	-	1	1	-
9-Sep-02	-	-	-	-	1	-	-
10-Sep-02	-	-	-	-	-	2	-
11-Sep-02	-	-	-	-	-	1	-
12-Sep-02	1	-	-	-	-	1	-
13-Sep-02	-	-	-	-	1	2	-
14-Sep-02	1	-	-	-	-	-	-
16-Sep-02	-	-	-	-	1	3	-
17-Sep-02	-	-	-	-	-	1	-
18-Sep-02	-	-	-	-	-	1	-
21-Sep-02	-	-	-	-	1	-	-
26-Sep-02	-	-	-	-	-	1	-
27-Sep-02	-	-	-	-	-	2	-
28-Sep-02	-	-	-	-	1	2	-
29-Sep-02	-	-	-	-	1	5	-
30-Sep-02	-	-	-	-	1	6	-
1-Oct-02	-	-	-	-	2	6	-
3-Oct-02	-	-	-	-	-	2	-
4-Oct-02	-	-	-	-	3	11	-
5-Oct-02	-	-	-	-	2	6	-
6-Oct-02	-	-	-	-	1	6	-
7-Oct-02	-	-	-	-	1	1	-
9-Oct-02	-	-	-	-	-	1	-
10-Oct-02	-	-	-	-	1	3	-
11-Oct-02	-	-	-	-	-	2	-
13-Oct-02	-	-	-	-	1	2	-
14-Oct-02	-	-	-	-	-	4	-
15-Oct-02	-	-	-	-	1	1	-

Appendix Table B4. Continued.

Detection date	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
17-Oct-02	-	-	-	-	-	1	-
19-Oct-02	-	-	-	-	-	2	-
20-Oct-02	-	-	-	-	-	1	-
21-Oct-02	-	-	-	-	-	1	-
24-Oct-02	-	-	-	-	-	1	-
26-Oct-02	-	-	-	-	-	2	-
27-Oct-02	-	-	-	-	-	1	-
28-Oct-02	-	-	-	-	-	2	-
29-Oct-02	-	-	-	-	-	1	-
30-Oct-02	-	-	-	-	-	1	-
31-Oct-02	-	-	-	-	1	4	-
1-Apr-03	-	-	-	-	5	-	-
2-Apr-03	-	-	-	-	9	-	-
3-Apr-03	-	-	-	-	5	1	-
4-Apr-03	-	-	-	-	5	1	-
5-Apr-03	-	-	-	-	3	2	-
6-Apr-03	-	-	-	-	8	3	-
7-Apr-03	-	-	-	-	4	-	-
8-Apr-03	-	-	-	-	-	2	-
9-Apr-03	-	-	-	-	4	1	-
10-Apr-03	-	-	-	-	2	2	-
11-Apr-03	-	-	-	-	5	-	-
12-Apr-03	-	-	-	-	10	-	-
13-Apr-03	-	-	-	-	11	2	-
14-Apr-03	-	-	-	-	12	-	-
15-Apr-03	-	-	-	-	37	3	-
16-Apr-03	-	-	-	-	10	3	-
17-Apr-03	-	-	-	-	10	1	-
18-Apr-03	-	-	-	-	16	1	-
19-Apr-03	-	-	-	-	11	2	-
20-Apr-03	-	-	-	-	7	-	-
21-Apr-03	-	-	-	-	18	-	-
22-Apr-03	-	-	-	1	14	-	-
23-Apr-03	-	-	-	-	25	1	-
24-Apr-03	-	-	-	-	9	-	-
25-Apr-03	-	-	-	-	9	-	-
26-Apr-03	-	-	-	-	6	-	-
27-Apr-03	-	-	-	-	8	-	-
28-Apr-03	-	-	-	-	5	-	-

Appendix Table B4. Continued.

Detection date	Detected once at Little Goose Dam (coil location)				Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway	Diversion	Sample	Raceway
29-Apr-03	-	-	-	-	5	-	-
30-Apr-03	-	-	-	-	1	-	-
1-May-03	-	-	-	-	4	-	-
2-May-03	-	-	-	-	1	-	-
3-May-03	-	-	-	-	1	-	-
4-May-03	-	-	-	-	2	-	-
5-May-03	-	-	-	-	1	-	-
6-May-03	-	-	-	-	3	-	-
7-May-03	-	-	-	-	2	-	-
8-May-03	-	-	-	-	1	-	-
9-May-03	-	-	-	-	1	-	-
11-May-03	-	-	-	-	2	-	-
12-May-03	-	-	-	-	3	-	-
13-May-03	-	-	-	-	2	-	-
14-May-03	-	-	-	-	2	-	-
15-May-03	-	-	-	-	3	-	-
16-May-03	-	-	-	-	3	-	-
18-May-03	-	-	-	-	1	-	-
20-May-03	-	-	-	-	3	-	-

Appendix Table B5. Locations of observations (detections) of PIT-tagged juvenile fall Chinook salmon within the Lower Monumental Dam juvenile fish facility, 2002 study year.

	Detected once at Lower Monumental Dam (coil location)	Detected on separator and one additional coil (coil location)		
Detection date	Separator	Diversion	Sample	Raceway
11-Jun-02	-	1	-	-
14-Jun-02	-	1	-	1
16-Jun-02	-	-	-	1
18-Jun-02	-	1	-	-
19-Jun-02	-	-	1	-
20-Jun-02	-	-	-	1
21-Jun-02	-	2	-	3
22-Jun-02	-	-	-	3
28-Jun-02	-	1	2	-
29-Jun-02	-	-	4	1
30-Jun-02	-	3	7	3
1-Jul-02	-	8	16	8
2-Jul-02	-	9	33	5
3-Jul-02	-	19	42	25
4-Jul-02	-	12	21	25
5-Jul-02	1	7	28	-
6-Jul-02	-	14	36	15
7-Jul-02	-	6	21	1
8-Jul-02	-	2	9	-
9-Jul-02	-	1	4	4
10-Jul-02	-	3	1	14
11-Jul-02	-	4	-	10
12-Jul-02	-	26	9	88
13-Jul-02	-	22	9	71
14-Jul-02	-	35	2	137
15-Jul-02	-	18	4	61
16-Jul-02	-	15	1	52
17-Jul-02	-	11	1	50
18-Jul-02	-	25	3	94
19-Jul-02	-	28	7	102
20-Jul-02	-	13	3	51
21-Jul-02	-	7	3	24
22-Jul-02	-	11	2	35
23-Jul-02	-	22	10	68
24-Jul-02	-	18	8	57
25-Jul-02	-	11	3	33
26-Jul-02	-	9	5	32
27-Jul-02	-	13	6	42
28-Jul-02	-	9	5	31
29-Jul-02	-	4	1	11
30-Jul-02	-	3	-	7
31-Jul-02	-	4	1	13
1-Aug-02	-	3	1	12
2-Aug-02	-	5	2	19

Appendix Table B5. Continued.

Detection date	Detected once at Lower Monumental Dam (coil location)	Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway
3-Aug-02	-	10	9	25
4-Aug-02	-	5	4	14
5-Aug-02	-	5	2	15
6-Aug-02	-	1	1	5
7-Aug-02	-	1	1	3
8-Aug-02	-	-	-	2
9-Aug-02	-	2	3	4
10-Aug-02	-	2	2	7
11-Aug-02	-	3	3	5
12-Aug-02	-	2	2	7
13-Aug-02	-	2	2	8
14-Aug-02	-	2	2	4
15-Aug-02	-	1	2	5
16-Aug-02	-	3	6	2
17-Aug-02	-	1	4	-
18-Aug-02	-	2	8	-
19-Aug-02	-	2	6	-
20-Aug-02	-	1	5	-
21-Aug-02	-	3	14	-
22-Aug-02	-	1	6	-
23-Aug-02	-	4	10	-
24-Aug-02	-	5	21	-
25-Aug-02	-	2	11	-
26-Aug-02	-	1	6	-
27-Aug-02	1	4	8	-
28-Aug-02	-	1	8	-
29-Aug-02	-	2	8	-
30-Aug-02	-	2	4	-
31-Aug-02	-	2	5	-
1-Sep-02	-	-	1	-
2-Sep-02	1	1	2	-
3-Sep-02	-	-	1	-
4-Sep-02	-	1	3	-
5-Sep-02	3	1	4	-
10-Sep-02	-	1	1	-
11-Sep-02	-	-	1	-
12-Sep-02	-	1	2	-
13-Sep-02	1	1	6	-
14-Sep-02	-	-	1	-
15-Sep-02	1	1	-	-
16-Sep-02	1	-	1	-
17-Sep-02	-	1	3	-
18-Sep-02	-	-	2	-
19-Sep-02	-	-	1	-
20-Sep-02	-	-	1	-

Appendix Table B5. Continued.

Detection date	Detected once at Lower Monumental Dam (coil location)	Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway
22-Sep-02	-	-	1	-
24-Sep-02	-	1	2	-
25-Sep-02	-	-	1	-
26-Sep-02	-	1	1	-
27-Sep-02	-	-	3	-
28-Sep-02	-	1	4	-
29-Sep-02	-	-	1	-
30-Sep-02	-	1	-	-
1-Oct-02	-	-	2	-
2-Oct-02	-	-	1	-
3-Oct-02	-	-	1	-
11-Oct-02	-	1	-	-
12-Oct-02	-	2	4	-
13-Oct-02	-	-	4	-
14-Oct-02	-	1	-	-
29-Oct-02	-	1	-	-
1-Apr-03	-	9	-	-
2-Apr-03	-	15	2	-
3-Apr-03	-	5	3	-
4-Apr-03	-	11	1	-
5-Apr-03	-	5	-	-
6-Apr-03	-	5	-	-
7-Apr-03	-	2	-	-
8-Apr-03	-	1	-	-
9-Apr-03	-	2	1	-
10-Apr-03	-	3	-	-
11-Apr-03	-	1	-	-
12-Apr-03	-	5	-	-
13-Apr-03	-	3	1	-
14-Apr-03	-	5	-	-
15-Apr-03	-	10	-	-
16-Apr-03	-	1	-	-
17-Apr-03	-	7	-	-
18-Apr-03	-	3	-	-
19-Apr-03	-	1	-	-
20-Apr-03	-	3	-	-
21-Apr-03	-	2	-	-
22-Apr-03	-	1	-	-
23-Apr-03	-	2	-	-
24-Apr-03	-	6	-	-
25-Apr-03	-	2	-	-
26-Apr-03	-	6	-	1
27-Apr-03	-	5	-	-
28-Apr-03	-	1	-	1
29-Apr-03	-	-	1	-
30-Apr-03	-	6	-	-

Appendix Table B5. Continued.

Detection date	Detected once at Lower Monumental Dam (coil location)	Detected on separator and one additional coil (coil location)		
	Separator	Diversion	Sample	Raceway
1-May-03	-	1	-	-
5-May-03	-	1	-	-
6-May-03	-	1	-	-
8-May-03	-	1	-	-
14-May-03	-	2	-	-
16-May-03	-	2	-	-
17-May-03	-	2	-	-
18-May-03	-	1	-	-
19-May-03	-	-	-	1
20-May-03	-	2	-	-
21-May-03	-	1	-	-

Appendix Table B6. Locations of observations (detections) of PIT-tagged fall Chinook salmon within the McNary Dam juvenile fish facility, 2002 study year.

Detection date	Detected once at McNary Dam (coil location)		Detected on Full Flow and additional coil(s) (coil location)		Detected on separator and additional coil(s) (coil location)			
	Full flow	Separator	Diversion	Sample	Sample Diversion	Diversion	Sample	Raceway
15-Jun-02	-	-	-	-	-	1	-	-
23-Jun-02	-	-	-	-	-	1	-	-
27-Jun-02	-	-	-	-	-	1	-	-
6-Jul-02	-	-	-	-	-	1	-	-
7-Jul-02	-	-	-	-	-	3	-	-
8-Jul-02	-	-	-	-	-	5	-	-
9-Jul-02	-	-	-	-	-	11	1	-
10-Jul-02	-	-	-	-	-	15	2	-
11-Jul-02	-	-	-	-	-	11	-	-
12-Jul-02	-	-	-	-	-	5	-	-
13-Jul-02	-	-	-	-	-	10	-	-
14-Jul-02	-	-	-	-	-	8	-	-
15-Jul-02	-	-	-	-	-	14	1	-
16-Jul-02	-	-	-	-	-	40	-	-
17-Jul-02	-	-	-	-	-	31	2	1
18-Jul-02	-	-	-	-	-	21	-	-
19-Jul-02	-	-	-	-	-	23	-	-
20-Jul-02	-	-	-	-	-	42	-	-
21-Jul-02	-	-	-	-	-	50	3	-
22-Jul-02	-	-	-	-	-	38	2	1
23-Jul-02	-	-	-	-	-	9	1	-
24-Jul-02	-	-	-	-	-	8	1	-
25-Jul-02	-	-	-	-	-	10	-	-
26-Jul-02	-	-	-	-	-	25	-	-
27-Jul-02	-	-	-	-	-	47	1	1
28-Jul-02	-	-	-	-	-	21	1	1
29-Jul-02	-	-	-	-	-	28	6	-
30-Jul-02	-	-	-	-	-	24	2	2
31-Jul-02	-	-	-	-	-	23	2	1
1-Aug-02	-	-	-	-	-	16	-	-
2-Aug-02	-	-	-	-	-	14	-	-
3-Aug-02	-	-	-	-	-	7	-	-
4-Aug-02	-	-	-	-	-	5	1	-
5-Aug-02	-	-	-	-	-	5	5	-
6-Aug-02	-	-	-	-	-	7	1	-
7-Aug-02	-	-	-	-	-	14	2	-
8-Aug-02	-	-	-	-	-	21	2	-
9-Aug-02	-	-	-	-	-	24	-	-
10-Aug-02	-	-	-	-	-	9	1	-
11-Aug-02	-	-	-	-	-	8	-	-
12-Aug-02	-	-	-	-	-	3	2	-
13-Aug-02	-	-	-	-	-	3	-	-
14-Aug-02	-	-	-	-	-	1	-	-

Appendix Table B6. Continued.

Detection date	Detected once at McNary Dam (coil location)		Detected on Full Flow and additional coil(s) (coil location)		Detected on separator and additional coil(s) (coil location)			
	Full flow	Separator	Diversion	Sample	Sample Diversion	Diversion	Sample	Raceway
15-Aug-02	-	-	-	-	-	2	-	-
16-Aug-02	-	-	-	-	-	5	-	-
17-Aug-02	-	-	-	-	-	3	-	-
18-Aug-02	-	-	-	-	-	6	-	-
19-Aug-02	-	-	-	-	-	3	-	-
21-Aug-02	-	-	-	-	-	5	-	-
22-Aug-02	-	-	-	-	-	1	-	-
23-Aug-02	-	-	-	-	-	3	-	-
24-Aug-02	-	-	-	-	-	4	-	-
25-Aug-02	-	-	-	-	-	2	1	-
26-Aug-02	-	-	-	-	-	2	-	-
27-Aug-02	-	-	-	-	-	3	-	-
28-Aug-02	-	-	-	-	-	2	-	-
29-Aug-02	-	-	-	-	-	4	1	-
31-Aug-02	-	-	-	-	-	2	-	-
1-Sep-02	-	-	-	-	-	1	1	-
2-Sep-02	-	-	-	-	-	-	2	-
4-Sep-02	-	-	-	-	-	1	-	-
6-Sep-02	-	-	-	-	-	1	-	-
7-Sep-02	-	-	-	-	-	1	-	-
9-Sep-02	-	-	-	-	-	1	-	-
15-Aug-02	-	-	-	-	-	2	-	-
16-Aug-02	-	-	-	-	-	5	-	-
17-Aug-02	-	-	-	-	-	3	-	-
18-Aug-02	-	-	-	-	-	6	-	-
19-Aug-02	-	-	-	-	-	3	-	-
21-Aug-02	-	-	-	-	-	5	-	-
22-Aug-02	-	-	-	-	-	1	-	-
23-Aug-02	-	-	-	-	-	3	-	-
24-Aug-02	-	-	-	-	-	4	-	-
25-Aug-02	-	-	-	-	-	2	1	-
26-Aug-02	-	-	-	-	-	2	-	-
27-Aug-02	-	-	-	-	-	3	-	-
28-Aug-02	-	-	-	-	-	2	-	-
29-Aug-02	-	-	-	-	-	4	1	-
31-Aug-02	-	-	-	-	-	2	-	-
1-Sep-02	-	-	-	-	-	1	1	-
2-Sep-02	-	-	-	-	-	-	2	-
4-Sep-02	-	-	-	-	-	1	-	-
6-Sep-02	-	-	-	-	-	1	-	-
7-Sep-02	-	-	-	-	-	1	-	-
9-Sep-02	-	-	-	-	-	1	-	-
13-Sep-02	-	-	-	-	-	2	-	-
14-Sep-02	-	-	-	-	-	-	1	-
15-Sep-02	-	-	-	-	-	1	-	-

Appendix Table B6. Continued.

	Detected once at McNary Dam (coil location)		Detected on Full Flow and additional coil(s) (coil location)					
			Detected on separator and additional coil(s) (coil location)					
Detection date	Full flow	Separator	Diversion	Sample	Sample Diversion	Diversion	Sample	Raceway
19-Sep-02	-	-	-	-	-	-	1	-
24-Sep-02	-	-	-	-	-	1	-	-
30-Sep-02	-	-	-	-	-	1	-	-
3-Oct-02	-	-	-	-	-	1	-	-
14-Nov-02	-	-	-	-	-	3	-	-
16-Nov-02	-	-	-	-	-	2	-	-
18-Nov-02	-	-	-	-	-	2	1	-
19-Nov-02	-	-	-	-	-	1	-	-
22-Nov-02	-	-	-	-	-	2	-	-
24-Nov-02	-	-	-	-	-	1	1	-
5-Dec-02	-	-	-	-	-	1	-	-
7-Dec-02	-	-	-	-	-	-	1	-
8-Dec-02	-	-	-	-	-	-	1	-
9-Dec-02	-	-	-	-	-	2	-	-
10-Dec-02	-	-	-	-	-	3	-	1
31-Mar-03	4	-	-	-	-	-	-	-
1-Apr-03	4	-	-	-	-	-	-	-
2-Apr-03	7	-	4	1	-	-	-	-
3-Apr-03	11	-	2	-	-	-	-	-
4-Apr-03	7	-	14	-	2	-	-	-
5-Apr-03	13	-	3	-	-	-	-	-
6-Apr-03	3	-	5	1	1	-	-	-
7-Apr-03	15	-	2	-	1	-	-	-
8-Apr-03	2	-	8	-	2	-	-	-
9-Apr-03	14	-	2	-	1	-	-	-
10-Apr-03	3	-	10	-	1	-	-	-
11-Apr-03	10	-	-	-	-	-	-	-
12-Apr-03	1	-	11	-	3	-	-	-
13-Apr-03	19	-	3	-	-	-	-	-
14-Apr-03	1	-	12	-	2	-	-	-
15-Apr-03	15	-	2	-	-	-	-	-
16-Apr-03	2	-	11	-	-	-	-	-
17-Apr-03	11	-	1	-	-	-	-	-
18-Apr-03	1	-	6	-	-	-	-	-
19-Apr-03	12	-	1	-	-	-	-	-
20-Apr-03	1	-	6	-	-	-	-	-
21-Apr-03	2	-	-	-	-	-	-	-
22-Apr-03	3	-	13	-	-	-	-	-
23-Apr-03	7	-	2	-	-	-	-	-
24-Apr-03	1	-	5	-	-	-	-	-
25-Apr-03	8	-	1	-	-	-	-	-
26-Apr-03	1	-	11	-	-	-	-	-
27-Apr-03	6	-	4	-	-	-	-	-
28-Apr-03	5	-	5	-	-	-	-	-
29-Apr-03	9	-	1	-	-	-	-	-

Appendix Table B6. Continued.

Detection date	Detected once at McNary Dam (coil location)		Detected on Full Flow and additional coil(s) (coil location)		Detected on separator and additional coil(s) (coil location)			
	Full flow	Separator	Diversion	Sample	Sample Diversion	Diversion	Sample	Raceway
30-Apr-03	3	-	9	-	-	-	-	1
1-May-03	12	-	1	-	-	-	-	-
2-May-03	3	-	4	-	-	-	-	-
3-May-03	7	-	-	-	-	-	-	-
4-May-03	1	-	1	-	-	-	-	-
5-May-03	1	-	-	-	-	-	-	-
6-May-03	-	-	5	-	-	-	-	-
7-May-03	2	-	-	-	-	-	-	-
8-May-03	-	-	2	-	-	-	-	-
9-May-03	2	-	-	-	-	-	-	-
10-May-03	2	-	-	-	-	-	-	-
11-May-03	3	-	-	-	-	-	-	-
12-May-03	1	1	2	-	-	-	-	-
14-May-03	-	-	1	-	-	-	-	-
15-May-03	1	-	-	-	-	-	-	-
16-May-03	1	-	2	-	-	-	-	-
17-May-03	3	-	-	-	-	-	-	-
20-May-03	3	-	-	-	-	-	-	-
21-May-03	1	-	-	-	-	-	-	-
22-May-03	-	-	1	-	-	-	-	-
25-May-03	1	-	-	-	-	-	-	-
26-May-03	1	-	-	-	-	-	-	-

APPENDIX C

Adult Returns from Previous and In-progress Studies

Appendix Table C1. Snake River hatchery fall Chinook salmon studies.

Tagging year	Juvenile fish numbers		Returns by age-class					SAR					Annual Report containing final results
	Transport	Bypass	Jack	2-ocean	3-ocean	4-ocean	5-ocean	Transport	Bypass	T/I	95% C.I.	Status	
2006[a]	270,639	220,523	--	--	--	--	--	--	--	--	--	In-progress	2010
2005[a]	84,844	83,272	80	--	--	--	--	--	--	--	--	In-progress	2009
2004[b]	3,617	45,296	27	27	--	--	--	--	--	--	--	In-progress	2008
2003	16,109	19,161	56	48	31	--	--	--	--	--	--	In-progress	2007
2002[c]	**12,344**	**3,990**	**101**	**159**	**64**	**20**	**--**	**0.98**	**0.83**	**--**	**--**	**Completed**	**2006**
2001[c]	**18,904**	**2,429**	**33**	**38**	**17**	**7**	**0**	**0.23**	**0.49**	**--**	**--**	**Completed**	**2006**

[a] These fish were tagged at Dworshak Hatchery as part of a joint NOAA Fisheries/U. S. Fish and Wildlife Service study. Fish were assigned to either a “Transport” or “Bypass” group prior to release.

[b] These fish were tagged at Lower Granite Dam from 2 June to 30 July 2004.

[c] Juvenile “Bypass” numbers are raw numbers, not adjusted using the methodology of Sandford & Smith (2002).